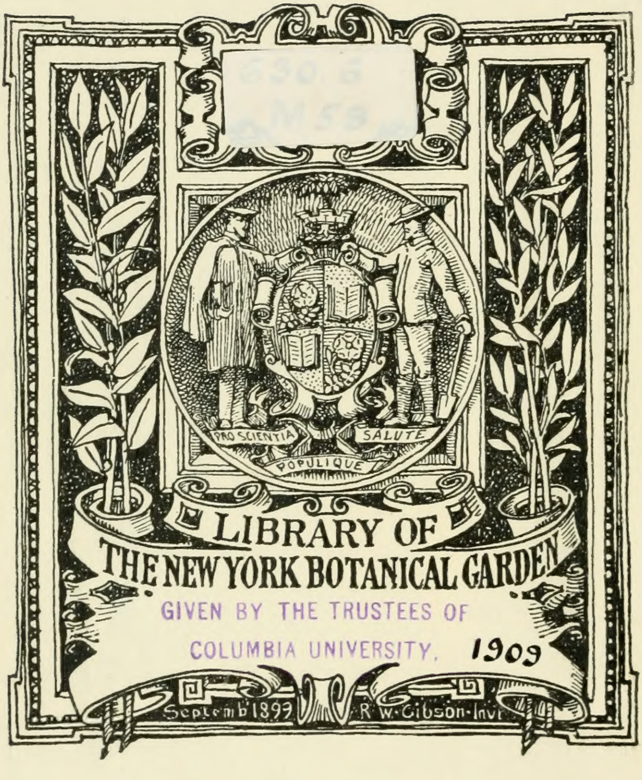
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FORTY-SIXTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

OF THE

STATE OF MICHIGAN

AND

TWENTIETH ANNUAL REPORT

OF THE

EXPERIMENT STATION

FROM

JULY 1, 1906, TO JUNE 30, 1907.

BY AUTHORITY

LANSING, MICHIGAN
WYNKOOP HALLENBECK CRAWFORD CO., STATE PRINTERS
1907

REPORT OF THE SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

AGRICULTURAL COLLEGE, *July 1, 1907.*

TO HON. FRED M. WARNER,

Governor of the State of Michigan:

SIR—I have the honor to submit to you herewith, as required by law, the accompanying report for the fiscal year ending June 30, 1907, with supplementary papers.

Very respectfully,

ADDISON M. BROWN,

Secretary of the State Board of Agriculture.

STATE BOARD OF AGRICULTURE.

	Term Expires.
CHARLES J. MONROE, South Haven,	1907
President of the Board.	
HENRY F. BUSKIRK, Wayland,	1907
WILLIAM H. WALLACE, Bayport,	1909
AARON P. BLISS, Saginaw,	1909
ROBERT D. GRAHAM, Grand Rapids,	1911
THOMAS F. MARSTON, Bay City,	1911
WILLIAM J. OBERDORFFER, Stephenson,	1911
*ALFRED J. DOHERTY, Clare,	1913
*I. ROY WATERBURY, Highland Station,	1913
FRED M. WARNER, Governor of the State,	*Ex-Officio.*
JONATHAN L. SNYDER, President of the College,	*Ex-Officio.*

A. M. BROWN, Agricultural College, Secretary.
B. F. DAVIS, Lansing, Treasurer.

STANDING COMMITTEES.

The President of the Board is *ex-officio* a member of each of the Standing Committees.

Botany and Horticulture,	R. D. Graham, H. F. Buskirk.
Buildings and College Property,	A. P. Bliss, W. H. Wallace.
Chemical, Physical, Bacteriological and other Departments not otherwise provided for,	A. P. Bliss, T. F. Marston.
Employes,	R. D. Graham, H. F. Buskirk, J. L. Snyder.
English and Mathematics,	W. H. Wallace, T. F. Marston.
Experiment Station,	H. F. Buskirk, A. P. Bliss.
Farm Management,	T. F. Marston, R. D. Graham.
Finance,	R. D. Graham, A. P. Bliss.
Forestry,	A. P. Bliss, H. F. Buskirk.
Farmers' Institutes,	T. F. Marston, R. D. Graham.
Land Grant,	H. F. Buskirk, W. H. Wallace.
Library,	W. H. Wallace, A. P. Bliss.
Mechanical Department,	W. H. Wallace, R. D. Graham.
Military and Athletic,	T. F. Marston, W. H. Wallace.
Women's Department,	H. F. Buskirk, T. F. Marston.

*Appointment made.

STATE AGRICULTURAL COLLEGE

(Under control of the State Board of Agriculture.)

FACULTY AND OTHER OFFICERS.

Jonathan L. Snyder, A. M., Ph. D., President; [a,b,c] Feb. 25, '96.

Wm. J. Beal, Ph. D., D. Sc., Professor of Botany; [a,b] July 9, '70; [c] Sept. 1, '02.

Frank S. Kedzie, M. S., Professor of Chemistry; [a] Sept. 15, '08; [b,c] Sept. 1, '02.

William S. Holdsworth, M. S., Professor of Drawing; [a] Feb. 22, '81; [b] Aug. 22, '87; [c] Sept. 1, '03.

Levi R. Taft, M. S., Superintendent of Farmers' Institutes and State Inspector of Orchards and Nurseries; [a] Aug. 1, '88; [b,c] July 1, '02.

*Howard Edwards, A. M., LL. D., Professor of English Literature and Modern Languages; [a,b,c] Aug. 25, '90.

Herman K. Vedder, C. E., Professor of Mathematics and Civil Engineering; [a,b,c] Sept. 15, '91.

Clinton D. Smith, M. S., Dean of Short Courses, College Extension Lecturer; [a,b] Sept. 1, '93; [c] July 1, '02.

*a Charles L. Weil, B. S., Professor of Mechanical Engineering and Director of the Mechanical Department; [a,b,c] Sept. 1, '93.

Walter B. Barrows, B. S., Professor of Zoology and Physiology and Curator of the General Museum; [a,b,c] Feb. 15, '94.

George A. Waterman, B. S., M. D. C., Professor of Veterinary Science; [a,b,c] Sept. 1, '98.

Charles E. Marshall, Ph. D., Professor of Bacteriology and Hygiene; [a] Sept. 1, '98; [b,c] Sept. 1, '02.

Joseph A. Jeffery, B. S. A., Professor of Agronomy and Soil Physics; [a] Sept. 1, '99; [b,c] Nov. 11, '02.

Maud Gilchrist, B. S., Dean of the Women's Department; [a,b,c] Sept. 1, '01.

Addison M. Brown, A. B., Secretary; [a,b,c] June 1, '02.

Robert S. Shaw, B. S. A., Professor of Agriculture and Superintendent of Farm; [a,b,c] Sept. 1, '02.

Ernest E. Bogue, M. S., A. M., Professor of Forestry; [a,b,c] Sept. 1, '02.

Arthur R. Sawyer, E. E., Professor of Physics and Electrical Engineering; [a,b,c] April 11, '04.

S. W. Fletcher, M. S., Ph. D., Professor of Horticulture and Landscape Gardening; [a,b,c] Sept. 1, '05.

Capt. F. W. Fueger, U. S. A., Professor of Military Science and Tactics; [a,b,c] Sept. 1, '05.

RUFUS H. PETTIT, B. S. A., Professor of Entomology; [a] Jan. 1, '97; [b c] Sept. 1, '06.

THOMAS C. BLAISDELL, Ph. D., Professor of English Literature and Modern Languages; [a b c] Sept. 1, '07.

WILBUR O. HEDRICK, M. S., Professor of History and Political Economy; [a b] Aug. 24, '91; [c] June 20, '06.

ELIZABETH S. JONES, A. B., Acting Dean of Women's Dept.; [a b c] Sept. 1, 06.

GEORGE W. BISSELL, M. E., Dean of Engineering; [a b c] June 18, '07.

WARREN BABCOCK, B. S., Associate Professor of Mathematics; [a b] June 30, '91; [c] Sept. 1, '05.

E. SYLVESTER KING, Assistant Professor of English; [a] Jan. 1, '00; [b c] Sept. 1, '02.

JAMES B. DANDENO, Ph. D., Assistant Professor of Botany; [a b c] Sept. 1 '02.

The names of instructors whose resignations took effect between June 30 and Sept. 1, '06, do not appear below.

THOMAS GUNSON, Instructor in Horticulture and Superintendent of Grounds; [a b] April 1, '91; [c] Sept. 1, '05.

MRS. LINDA E. LANDON, Librarian; [a b c] Aug. 24, '91.

MRS. JENNIE L. K. HANER, Instructor in Domestic Art; [a b c] Sept. 1, '97.

CHACE NEWMAN, Instructor in Mechanical Drawing; [a b] Sept. 1, '97; [c] July 23, '01.

E. C. BAKER, Foreman of Foundry; [a b c] Nov. 1, '97.

CAROLINE L. HOLT, Instructor in Drawing; [a b c] Sept. 1, '98.

BERTHA M. WELLMAN, B. S., B. Pd., Instructor in English; [a b c] Sept. 1, '00.

JESSE J. MYERS, B. S., Instructor in Zoology; [a b c] Sept. 1, '01.

LOUISE FREYHOFER, B. S., Instructor in Music; [a b c] Sept. 1, '02.

HARRY S. REED, Instructor in Chemistry; [a b c] Sept. 1, '02.

ANDREW KRENTEL, Foreman Wood Shop; [a b c] Sept. 1, '02.

H. W. NORTON, JR., B. S., Instructor in Animal Husbandry; [a b c] Sept. 1, '03.

HARVEY L. CURTIS, A. M., Instructor in Physics; [a b c] Sept. 1, '03.

CHESTER L. BREWER, B. S., Director of Physical Culture; [a b c] Sept. 1, '03.

ALBERT E. JONES, A. B., Instructor in Mathematics; [a b c] Sept. 15, '03.

*b C. A. MCCUE, B. S., Instructor in Horticulture; [a b c] Oct. 1, '03.

LESLIE B. MCWETHY, B. S., Instructor in Agriculture; [a b c] June 1, '04.

CARL GUNDERSEN, A. M., Ph. D., Instructor in Mathematics; [a b c] Sept. 1, '04.

WALTER G. SACKETT, B. S., Instructor in Bacteriology and Hygiene; [a b c] Sept. 1, '04.

FLOYD O. FOSTER, B. S., Instructor in Dairying; [a b c] Sept. 1, '04.

MARY WETMORE, M. D., Instructor in Bacteriology; [a b c] Sept. 1, '04

ARCHIE R. ALGER, B. S., Instructor in Mathematics; [a b c] Nov. 15, '04.

E. H. RYDER, A. M., Instructor in History and Economics; [a b c] Sept. 1, '05.

BESSIE BEMIS, B. S., Instructor in Cookery; [a b c] Sept. 1, '05.

NORMA L. GILCHRIST, A. B., Instructor in English; [a b c] Sept. 1, '05.
GLENN JAMES, A. B., Instructor in Mathematics; [a b c] Sept. 1, '05.

L. D. BUSHNELL, B. S., Assistant in Bacteriology; [a b c] Sept. 1, '05.
S. C. HADDEN, B. S., Instructor in Mathematics and Civil Engineering; [a b c] Sept, 1. '05.
G. L. STEVENS, A. B., Lit. B., Instructor in English; [a b c] Sept. 1, '05.
A. CROSBY ANDERSON, B. S., Instructor in Animal Husbandry; [a b c] Sept. 1, '05.
ARTHUR R. KOHLER, B. S. A., Instructor in Horticulture; [a b c] April 1, '06.
JAMES G. HALPIN, B. S., Instructor in Poultry Husbandry; [a b c] July 1, '06.
CHARLES BROWN, B. S., Assistant in Bacteriology; [a b c] Aug. 15, '06.
BESSIE K. PADDOCK, B. S., Instructor in English; [a b c] Sept. 1, '06.
LOUISE WAUGH, B. S., Instructor in Domestic Science; [a b c] Sept. 1, '06.
ERASTUS N. BATES, B. S., Instructor in Physics; [a b c] Sept. 1, '06.
LESLIE J. SMITH, B. S., Instructor in Farm Mechanics; [a b c] July 1, '06.
GRACE L. CHAPMAN, A. B., Instructor in Calisthenics; [a b c] Sept. 1, '06.
ARTHUR J. CLARK, A. B., Instructor in Chemistry; [a b c] Sept. 1, '06.
HERBERT S. BAILEY, B. S., Instructor in Chemistry; [a b c] Sept. 1, '06.
FRED J. KAUFMAN, B. S., Instructor in Chemistry; [a b c] Sept. 1, '06.
WILLIAM E. LAWRENCE, B. S., Instructor in Botany; [a b c] Sept. 1, '06.
*d HENRY F. SCHMIDT, Instructor in Mechanical Engineering; [a b c] Sept. 1, '06.
FRANK M. GRACEY, Instructor in Drawing; [a b c] Sept. 1, '06.
JOSEPH H. TAYLOR, B. S., Instructor in Civil Engineering; [a b c] Sept. 1, '06.
BELLE FARRAND, B. S., Assistant in Bacteriology; [a b c] Sept. 1, '06.
JAMES R. KELTON, B. S., Instructor in Zoology; [a b c] Sept. 1, '06.
WILEY B. WENDT, B. C. E., Instructor in Civil Engineering; [a b c] Sept. 1, '06.
JOSEPH H. POLSON, B. S., Instructor in Mechanical Engineering; [a b c] Sept. 1, '06.
W. LLOYD LODGE, B. Sc., M. A., Instructor in Physics; [a b c] Oct. 1, '06.
F. HOBART SANFORD, B. S., Instructor in Forestry; [a b c] Dec. 1, '06.
*e LEO M. WATSON, Instructor in Drawing; [a b c] Jan. 1, '07.
CHARLES W. CHAPMAN, Instructor in Physics; [a b c] Jan. 1, '07.
LOUIS APPLEYARD, B. S., Instructor in Mechanical Engineering; [a b c] Jan. 14, '07.
CHARLES P. HALLIGAN, B. S., Instructor in Horticulture; [a b c] April 8, '07.
WILLIAM S. SAYER, B. S., Assistant in Bacteriology; [a b c] May 1, '07.
LEE CHAPPELLE, Foreman of Machine Shop; [a b c] Sept. 1, '06.
WILLIAM HOLMES, Foreman of Forge Shop; [a b c] Sept. 1, '06.
FRED C. KENNEY, Cashier; [a b] Sept. 18, '95; [c] Oct. 1, '97.
S. ALICE EARL, Clerk to Secretary; [a b c] Oct. 1, '02.
*f COWAN H. MCGUGAN, Bookkeeper; [a b c] June 1, '05.
JACOB SCHEPERS, Assistant Cashier; [a b c] May 1, '07.
LUTHER F. JENISON, Bookkeeper; [a b c] May 1, '07.
ELIDA YAKELEY, Secretary to President; [a] July 15, '03; [b c] Feb. 1, '06.

B. A. Faunce, Clerk to President and Editor M. A. C. Record; [a,b,c] Sept. 1, '04.

L. F. Newell, Engineer; [a,b,c] Jan. 1, '98.

E. A. Bowd, Architect; [a,b,c] Jan. 1, '02.

Rowena Ketchum, in charge of College Hospital; [a,b,c] Sept. 1, '00.

Cora L. Feldkamp, B. S., Assistant Librarian; [a,b,c] Sept. 1, '05.

a First appointment
b Present appointment
c Present title
* Resigned September 1, 1906.
*a " October 1, 1906.
*b " March 15, 1907.
*c " May 1, 1907.
*d " Jan. 20, 1907.
*e " April 1, 1907.
*f " March, 1907.

AGRICULTURAL EXPERIMENT STATION

OF THE

MICHIGAN AGRICULTURAL COLLEGE

(Under the control of the State Board of Agriculture.)

STATION COUNCIL.

J. L. Snyder, M. A., Ph. D., Pres., *Ex-officio* Member.
Clinton D. Smith, M. S., Director.
L. R. Taft, M. S., - Horticulturist.
R. H. Pettit, B. S. A., Entomologist.
A. J. Patten, B. S., - Chemist.
Chas E. Marshall, Ph. D., Bacteriologist and Hygienist.
R. S. Shaw, B. S. A., Experimenter with Live Stock.
A. M. Brown, A. B., - Sec. and Treas.

ADVISORY AND ASSISTANT STAFF.

S. W. Fletcher, M. S., Ph. D., Associate Horticulturist.
Geo. A. Waterman, V. S., M. D. C., Consulting Veterinarian.
Mrs. L. E. Landon, - Librarian.
W. G. Sackett, B. S., Asst. in Bacteriology and Hygiene.
C. A. McCue, Assistant Horticulturist.
Leo M. Geismar, Chatham, In Charge of Upper Peninsula Exp'm't Station.
F. A. Wilken, - In Charge of South Haven Sub-Station.

SUB-STATIONS.

Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded. Local agent, F. A. Wilken.
Chatham, Alger County, 160 acres deeded. Local agent, Leo M. Geismar.

STANDING COMMITTEE IN CHARGE.

Hon. F. H. Buskirk, - - - - - - - - - Wayland.
Hon. A. P. Bliss, - - - - - - - - - Saginaw.

STATE WEATHER SERVICE

(Under control of the State Board of Agriculture.)

C. F. Schneider, Director U. S. Weather Bureau - - - Grand Rapids.

ACCOUNTS OF THE STATE AGRICULTURAL COLLEGE.

FOR THE YEAR ENDING JUNE 30, 1907.

SECRETARY'S FINANCIAL REPORT.

			Dr.	Cr.
July 1, 1906.	To cash on deposit, college treasurer		$22,533 50	
July 1, 1906.	To cash on hand		1,840 23	
June 30, 1907.	To special appropriation receipts		182,504 70	
	From State Treasurer	$151,000 00		
	From United States Treasurer	23,691 60		
	From institution and other sources	7,813 10		
June 30, 1907.	By special appropriation disbursements			$193,692 66
June 30, 1907.	To current account receipts		231,679 78	
	From State Treasurer, land grant interest	70,155 22		
	From State Treasurer, one-tenth mill tax	70,000 00		
	From U. S. Treasurer, Morrill fund	25,000 00		
	From institutions and other sources	64,699 31		
	From South Haven Experiment Station	636 91		
	From Upper Peninsula Experiment Station	1,188 34		
	By general account disbursement			225,265 21
	From current account	$208,402 48		
	From supplementary accounts	16,862 73		
June 30, 1907.	By cash on hand			3,802 62
June 30, 1907.	By cash on deposit			15,797 72
			$438,558 21	$438,558 21

TABLE No. 1.—*Tabular exhibit of secretary's report.*

	Balance sheet July 1, 1906.		Transactions, July 1, 1906, to June 30, 1907.		Balance sheet June 30, 1907.	
	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.
Cash	$1,840 23	....	....	$1,962 39	$3,802 62	....
College treasurer.*	22,533 50	....	$6,735 78	....	15,797 72	....
Special appropriations	....	$18,391 43	182,504 70	193,692 66	....	$7,203 47
Current accounts	....	5,982 30	229,854 53	208,402 48	....	12,396 87
Supplementary accounts	....	....	1,825 25	16,862 73	....	....
Totals	$24,373 73	$24,373 73	$420,920 26	$420,920 26	$19,600 34	$19,600 34

*Treasurer's statement is greater July 1, 1906, by $9,861.06, and June 30, 1907, by $14,719.83; warrants outstanding.

TREASURER'S ACCOUNT.

	Dr.	Cr.
Balance on hand July 1, 1906	$32,394 56	
Receipts from State Treasury and Secretary	411,509 66	
Interest on deposits, 2½ months at 2½ per cent	712 43	
Warrants paid July 1, 1906, to June 30, 1907		$414,099 10
Balance on hand June 30, 1907		30,517 55
Total	$444,616 65	$444,616 65

TABLE No. 2.—*Statement of special appropriation account for fiscal year, July 1, 1906, to June 30, 1907.*

Name of appropriation.	Balance of accounts, July 1, 1906.		Receipts during fiscal year.		Total available.	Total expended.	Balance of account June 30, 1907.	
	Dr.	Cr.	From State treasury.	From institution and other sources.			Dr.	Cr.
Experiment Station		$1,204 07	*$23,691 60	$4,304 23	$29,199 90	$28,885 37		$314 53
Nursery License and Inspection				1,077 51	1,077 51	1,077 51		
Sundry Improvements		1,303 21	15,000 00	247 15	16,550 36	15,775 96		774 40
Barns	$512 35		5,000 00	79 59	4,567 24	4,567 24		
Wells Hall		7,813 13	10,000 00		17,813 13	17,813 13		
Electric Light and Power Plant		4,207 75	15,000 00	130 65	19,338 40	19,338 40		
U. P. Experiment Station, special		2,529 96	4,000 00		6,529 96	6,099 83		430 13
Live Stock, Special		28 21	13,000 00	69 36	13,097 57	13,070 45		27 12
Live Stock, Special Poultry		276 59			276 59	276 59		
Live Stock, Special Poultry House		91 18			91 18	91 18		
Engineering Building		1,433 66	80,000 00	135 00	81,568 66	77,527 70		4,040 96
Semi-Centennial			8,000 00	1,769 61	9,769 61	8,202 18		1,567 43
Weather Bureau		16 02	1,000 00		1,016 02	967 12		48 90
Balance	18,391 43						$7,203 47	
Total	$18,903 78	$18,903 78	$174,691 60	$7,813 10	$200,896 13	$193,692 66	$7,203 47	$7,203 47

*U. S. Treasurer.

TABLE No. 3.—*Current account July 1, 1906, to June 30, 1907.*

On account of—	Dr. To disbursements.	Cr. By receipts.
U. S. Treasurer, 18th annual payment under act of congress of August 30, 1890	....	$25,000 00
State Treasurer, one-tenth mill tax	....	70,000 00
State Treasurer, interest on proceeds of sales of U S. land grant	....	70,155 22
Salaries	$87,509 50	1,072 00
Farm department	15,591 14	10,090 99
Horticultural department	6,687 03	2,444 94
Mechanical department	6,979 12	1,567 17
Heating department	14,267 03	600 89
Cleaning department	2,579 59	218 79
Electric lighting department	5,164 39	2,139 64
Office	1,874 69	200 97
Advertising	2,483 91	71 25
M. A. C. Record	1,149 41	510 75
Special courses	4,891 46	2,216 93
Academic departments	20,046 02	5,702 87
Contingent building	34,563 22	33,621 52
Miscellaneous	1,629 24	2,596 07
Women's	2,736 15	1,412 77
Ice	250 50	231 76
Total	$208,402 48	$229,854 53
Supplementary amounts:		
Bulletins	2,026 37	....
Farmers' institutes	8,363 24	....
South Haven experiment station	2,190 76	636 91
Upper Peninsula experiment station	4,282 36	1,188 34
Balance at beginning of period, July 1, 1906	....	5,982 30
Balance at close of period, June 30, 1907	12,396 87	....
Total	$237,662 08	$237,662 08

TABLE No. 4.—*Experiment station account, July 1, 1906, to June 30, 1907.*

On account of—	Dr. To disbursements.	Cr. By receipts.
Balance from fiscal year, July 1, 1906	....	$1,204 07
U. S. Treasurer for fiscal year	....	23,691 60
Bacteriological department	$4,849 78	....
Botanical department	46 62	....
Chemical department	2,492 09	8 83
Director's office	634 96	....
Entomological department	669 88	65 10
Farm department	4,181 67	423 41
Fertilizer license fees	....	2,840 00
Horticultural department	1,441 50	....
Library	729 37	10
Live Stock	116 90	349 97
Salaries	9,027 07	....
Secretary's office	763 58	315 29
Sundry	2,761 00	....
Veterinary department	1,170 95	301 53
Balance on hand June 30, 1907, close of fiscal year	314 53	....
Total	$29,199 90	$29,199 90

TABLE No. 5.—*Regular employes and salaries.*

Grade.	Rate per year.	Classification.		Other sources.	
		Current.	Experim't station.		
President's office.					
President	$5,000 00	$5,000 00			House.
Clerk	1,000 00	1,000 00			
Clerk	600 00	600 00			
Agricultural Department.					
Professor	2,500 00	2,100 00	$400 00		
Professor of Agronomy	2,000 00	2,000 00			
Instructor Animal Husbandry	1,200 00	1,200 00			
Ass't Instructor Animal Husbandry	1,200 00	1,200 00			
Instructor Dairying	1,200 00	1,200 00			
Instructor Agriculture	800 00	800 00			
Instructor Poultry Husbandry	1,000 00	1,000 00			
Instructor Farm Mechanics	700 00	700 00			
Foreman of College Farm	600 00	600 00			
Clerk, Farm Department	540 00	540 00			
Bacteriological Dept.					
Professor	2,000 00	1,000 00	1,000 00		
Instructor	1,200 00	1,050 00	150 00		
Instructor	500 00	500 00			
Instructor	360 00		360 00		
Instructor	500 00		500 00		
Instructor	360 00		360 00		
Botanical Department.					
Professor	1,800 00	1,800 00			House.
Assistant Professor	1,150 00	1,150 00			
Instructor	700 00	700 00			
Chemical Dept.					
Professor	2,000 00	2,000 00			
Instructor	1,200 00	1,200 00			
Instructor	800 00	800 00			
Instructor	700 00	700 00			
Instructor	700 00	700 00			
Chemist Exp. Station	1,500 00		1,500 00		
Drawing Dept.					
Professor	2,000 00	2,000 00			
Instructor Mechanical Drawing	1,180 00	1,180 00			
Instructor Drawing	700 00	700 00			
Instructor Mechanical Drawing	700 00	700 00			
Instructor	900 00	900 00			
English Dept.					
Professor	1,800 00	1,800 00			House.
Assistant Professor	1,000 00	1,000 00			Rooms.
Instructor	700 00	700 00			
Instructor	700 00	700 00			
Instructor	800 00	800 00			
Instructor	550 00	550 00			
Entomological Dept.					
Professor	1,400 00	800 00	600 00		House.
Forestry Dept.					
Professor	1,500 00	1,500 00			
Instructor	600 00	600 00			
Horticultural Dept.					
Professor	2,000 00	2,000 00			
Instructor	1,200 00	800 00	400 00		
Instructor	600 00	600 00			
Instructor	1,000 00	1,000 00			House.
Foreman of Grounds	500 00	500 00			House.
History and Pol. Economy Dept.					
Professor	1,700 00	1,700 00			
Instructor	1,000 00	1,000 00			
Institutes and Nursery Inspector.					
Superintendent	1,800 00	1,200 00	600 00		House.

TABLE No. 5.—*Concluded.*

Grade.	Rate per year.	Classification. Current.	Classification. Experim't station.	Other sources.	
Library Dept.					
Librarian	$1,000 00	$880 00	$120 00	....	Rooms.
Assistant Librarian	500 00	500 00	....	....	....
Mathematical Dept.					
Professor	1,800 00	1,800 00	....	....	House.
Assistant Professor	1,650 00	1,650 00	....	....	Rooms.
Instructor Civil Engineering	1,000 00	1,000 00	....	....	....
Instructor Civil Engineering	700 00	700 00	....	....	....
Instructor Civil Engineering	600 00	600 00	....	....	....
Instructor Mathematics	800 00	800 00	....	....	....
Instructor Mathematics	700 00	700 00	....	....	....
Instructor Mathematics	700 00	700 00	....	....	....
Instructor Mathematics	600 00	600 00	....	....	....
Mechanical Dept.					
Instructor	1,800 00	1,800 00	....	....	....
Instructor	1,200 00	1,200 00	....	....	....
Instructor in Forge Shop	800 00	800 00	....	....	....
Foreman Machine Shop	800 00	800 00	....	....	....
Foreman Wood Shop	800 00	800 00	....	....	....
Foreman Foundry	800 00	800 00	....	....	....
Clerk	540 00	540 00	....	....	....
Miscellaneous.					
Dean Short Courses	2,000 00	400 00	1,600 00	....	House.
Architect	1,500 00	1,500 00	....	....	....
Engineer	1,150 00	1,150 00	....	....	....
Plumber	900 00	900 00	....	....	....
Night Watchman	480 00	480 00	....	....	....
Nurse	450 00	450 00	....	....	....
Dept. of Physics.					
Professor	3,300 00	3,300 00	....	....	....
Instructor	1,000 00	1,000 00	....	....	....
Instructor	600 00	600 00	....	....	....
Instructor	850 00	850 00	....	....	....
Dept. of Physical Culture.					
Director	1,450 00	1,450 00	....	....	....
Secretary's Office.					
Secretary	1,800 00	300 00	500 00	$1,000 00	House.
Cashier	1,300 00	1,100 00	200 00	....	....
Bookkeeper	800 00	700 00	100 00	....	....
Clerk	600 00	475 00	125 00	....	....
Clerk	480 00	....	480 00	....	....
Veterinary Dept.					
Professor	1,600 00	1,300 00	300 00	....	....
Women's Dept.					
Dean	1,400 00	1,400 00	....	....	Rooms.
Instructor Sewing	800 00	800 00	....	....	Room.
Instructor Domestic Science	800 00	800 00	....	....	Room.
Instructor Physical Culture	500 00	500 00	....	....	Room.
Instructor Music	900 00	900 00	....	....	....
Instructor Cookery	600 00	600 00	....	....	Room.
Zoological Dept.					
Professor	1,800 00	1,800 00	....	....	House.
Instructor	1,000 00	1,000 00	....	....	House.
Instructor	900 00	900 00	....	....	....
Total pay roll	$103,890 00	$93,595 00	$9,295 00	$1,000 00	....

TABLE No. 6.—*Income of the State Agricultural College from all outside sources from the date of its foundation to the present time.*

Year.	From State Legislature. For current expenses.	From State Legislature. For special purposes.	From State Legislature. Land sales, salt spring and swamp land grants.	From U. S. Congress. Morrill act of 1862, interest from land grant and trespass.	From U. S. Congress. Hatch act of 1887, and Adams act of 1906, experiment station.	From U. S. Congress. Morrill act of 1890, supplementary endowment.	Total.
1855...	....	....	$56,320 00	....	....	....	$56,320 00
1856...	....	....	....	....	....	....	....
1857...	$40,000 00	....	....	....	....	....	40,000 00
1858...	....	....	....	....	....	....	....
1859...	37,500 00	....	....	....	....	....	37,500 00
1860...	....	....	....	....	....	....	....
1861...	6,500 00	....	152 25	....	....	....	6,652 25
1862...	10,000 00	....	218 97	....	....	....	10,218 97
1863...	9,000 00	....	407 80	....	....	....	9,407 80
1864...	9,000 00	....	726 09	....	....	....	9,726 09
1865...	15,000 00	....	1,156 61	....	....	....	16,156 61
1866...	15,000 00	....	1,094 27	....	....	....	16,094 27
1867...	20,000 00	....	7,608 38	....	....	....	27,608 38
1868...	20,000 00	....	592 49	....	....	....	20,592 49
1869...	20,000 00	$30,000 00	17,559 00	$58 96	....	....	67,617 96
1870...	20,000 00	....	1,320 02	2,720 93	....	....	24,040 95
1871...	18,250 00	10,500 00	4,135 72	3,785 54	....	....	36,671 26
1872...	18,250 00	3,000 00	217 05	7,175 65	....	....	28,642 70
1873...	21,796 00	15,602 00	10 13	11,059 06	....	....	48,467 19
1874...	13,000 00	15,602 00	150 13	14,061 98	....	....	42,814 11
1875...	7,638 00	7,755 50	144 53	14,446 14	....	....	29,984 17
1876...	7,638 00	6,755 50	1,773 09	16,830 17	....	....	32,996 76
1877...	6,150 00	30,686 80	979 06	15,172 86	....	....	52,988 72
1878...	6,150 00	5,686 80	826 60	15,807 09	....	....	28,470 49
1879...	4,971 80	16,068 32	712 22	16,978 22	....	....	38,730 56
1880...	4,971 80	7,068 32	797 55	17,837 24	....	....	30,674 91
1881...	7,249 00	43,720 50	461 95	20,935 25	....	....	72,366 70
1882...	7,249 00	8,945 50	358 46	22,507 45	....	....	39,060 41
1883...	8,385 00	23,793 00	391 95	30,749 60	....	....	63,319 55
1884...	8,385 00	10,526 00	1,259 90	27,909 72	....	....	48,080 62
1885...	....	35,103 00	187 50	29,770 40	....	....	65,060 90
1886...	....	22,617 00	....	30,461 04	....	....	53,078 04
1887...	....	*44,040 00	198 20	†24,611 37	....	....	68,849 57
1888...	....	30,752 50	144 20	32,406 60	$15,000 00	....	78,303 30
1889...	....	*20,973 00	10 50	31,322 69	15,000 00	....	67,306 19
1890...	....	*27,172 00	238 50	32,360 64	15,000 00	$15,000 00	89,771 14
1891...	....	22,947 50	37 38	34,750 54	15,000 00	16,000 00	88,735 42
1892...	....	22,947 50	137 38	34,948 12	15,000 00	17,000 00	90,033 00
1893...	....	18,862 50	10 50	37,927 04	15,000 00	18,000 00	89,800 04
1894...	....	18,862 50	433 59	44,527 26	15,000 00	19,000 00	97,823 35
1895...	....	‡19,000 00	10 50	45,301 85	15,000 00	20,000 00	99,312 35
1896...	....	‡16,000 00	....	43,886 40	15,000 00	21,000 00	95,886 40
1897...	....	§17,700 00	....	43,779 54	15,000 00	22,000 00	98,479 54
1898...	....	‖17,500 00	....	47,508 28	15,000 00	23,000 00	103,008 28
1899...	....	¶8,750 00	705 00	52,526 11	15,000 00	24,000 00	100,981 11
1900...	....	¶72,500 00	175 00	72,298 38	15,000 00	25,000 00	184,973 38
1901‡‡.	....	¶72,500 00	....	63,976 79	15,000 00	25,000 00	176,476 79
1902...	100,000 00	**1,000 00	....	64,081 81	15,000 00	25,000 00	205,081 81
1903...	100,000 00	**1,000 00	....	65,573 90	15,000 00	25,000 00	206,573 90
1904...	100,000 00	**1,000 00	61 19	67,312 37	15,000 00	25,000 00	208,373 50
1905...	100,000 00	*81,000 00	....	72,035 32	15,000 00	25,000 00	293,035 32
1906...	157,810 00	*15,000 00	....	70,286 56	15,000 00	25,000 00	284,096 56
1907...	173,410 00	**1,000 00	....	70,155 22	23,691 60	25,000 00	293,256 82
Totals .	$1093303 60	$823,937 74	$101,723 66	$1,349,84409	$308,691 60	$395,000 00	$4,072,50069

*Including appropriation for weather service.
†October 1, 1886, to June 30, 1887, nine months.
‡Including $5,000 for institutes and $1,000 for weather serviee.
¶Including $5,500 for institutes and $1,000 for weather service.
‖Including $5,500 for institutes and $1,000 for weather service.
§Including $2,750 for institutes and $500 for weather service.
††To June 30. **Weather service.

SUMMARY OF INVENTORY, JUNE 30, 1906.

College farm and park, 671 acres @ $70		$46,970 00
Athletic field and drive, 13 acres @ $87 .50		1,137 50
Buildings—		
Library and museum, built 1881	$22,000 00	
College hall, built 1856	17,000 00	
Wells hall, rebuilt 1905–06	55,000 00	
Williams hall, built 1869	30,000 00	
Abbot hall, built 1888, add. in 1896	15,000 00	
Chemical laboratory, built in 1871, south end add. 1881	18,000 00	
Machine shops and foundry, 1885, south end add. 1887	15,000 00	
Veterinary laboratory, built 1885	5,000 00	
Horticultural laboratory, built 1888	7,000 00	
Agricultural laboratory, built 1889, imp. 1897	7,500 00	
Botanical laboratory, built 1892	10,000 00	
Armory, built 1885	6,000 00	
Greenhouses and stable, built 1873, 1879; rebuilt 1892 and 1902	6,000 00	
Boiler house and chimney, built 1893–4	3,000 00	
President's and two frame dwellings, built 1874	12,000 00	
Six brick dwellings, built 1857, 1879, and 1884	18,000 00	
One frame dwelling, built 1885	3,500 00	
Howard terrace dwelling, built 1888	13,000 00	
Farm house dwelling, built 1869	2,000 00	
Herdsman's dwelling, built 1867	400 00	
Seven barns at professors' houses	1,050 00	
Horticultural barn and shed, built 1868, '75, '87	1,200 00	
Cattle barn and shed, built 1862	1,500 00	
Sheep barn, built 1865	1,000 00	
Horse barn, built 1871	1,000 00	
Piggery, built 1871	1,000 00	
Corn barn, built 1878	400 00	
Grade herd barn, built 1905	4,000 00	
Horse sheds, built 1894	200 00	
Tool barn, built 1881	1,000 00	
Brickwork shop, built 1857	500 00	
Observatory, built 1880	100 00	
Bath house and fittings, built 1902–3	17,000 00	
Paint shop, built 1879	150 00	
Hospital, built 1894	3,000 00	
Bull barn, built 1905	1,500 00	
Waiting room street car terminus, built 1902	1,700 00	
Street car track and fixtures, 600 ft., built 1897	360 00	
Lumber shed, mechanical department	250 00	
Silo	210 00	
Coal shed, built 1899	700 00	
Women's building, built 1900	91,000 00	
Dairy barn, built 1900	4,000 00	
Dairy building built 1900	15,000 00	
Bacteriological laboratory, built 1902	27,000 00	
Power house, built 1904	25,000 00	
Coal shed, built 1905	6,500 00	
Tunnel system	45,000 00	
Cold storage, rebuilt 1905	2,000 00	
		518,720 00
Amount carried forward		$566,827 50

Amount brought forward		$566,827 50
Iron bridge over Cedar river, built 1888		1,500 00
Dynamo at Agricultural laboratory		280 00
Bridge to athletic field		516 50
Heat, light and water department—		
Stock	$68 55	
Brass goods	45 00	
Coal	2,500 00	
Water works plant	12,874 00	
Electric light plant	6,880 00	
Steam heating plant	30,192 00	
Bath house plant	698 00	
Tools and fixtures	1,262 90	
Electric light stock	207 60	
		54,728 05
Bacteriological Department—		
Apparatus	$4,635 88	
Chemicals	209 86	
Office fixtures	1,210 45	
Books and pamphlets	48 30	
		6,104 49
Botanical Department—		
Herbarium	$11,075 80	
Museum	767 95	
Books	372 41	
Maps and charts	396 00	
Negatives	239 58	
Photographs and engravings	943 05	
Lantern slides	263 25	
Microscopes and accessories	1,801 14	
Glassware	430 08	
Chemicals, stains, etc	50 49	
Office and class room equipment	733 07	
Garden tools	44 36	
General equipment	173 15	
		17,290 33
Chemical Department—		
Cases and fixtures	$3,192 95	
Specimens	393 00	
Balances	1,700 50	
Weights	674 20	
Mercury	64 00	
Glassware, ungraduated	3,365 05	
Glassware, graduated	1,015 65	
Porcelain ware	557 55	
Wooden apparatus	160 78	
Rubber material	80 00	
Platinum ware	1,678 43	
Electrical apparatus	1,208 75	
Metals	71 37	
Special apparatus	1,878 65	
Miscellaneous	186 78	
Assay room supplies	100 82	
Chemicals, inorganic	538 97	
Acids	65 14	
Chemicals, organic	299 12	
Miscellaneous samples	17 35	
Tools	64 55	
Hardware	822 67	
		18,136 28
Amount carried forward		$665,383 15

Amount brought forward		$665,383 15
Farm Department—		
Live stock, cattle	$7,850 00	
Live stock, swine	1,196 50	
Live stock, sheep	1,560 00	
Live stock, horses	1,150 00	
Agronomy division	1,781 54	
Agronomy office	70 34	
Lower class room	42 70	
Upper class room	160 00	
Tool barn	700 20	
Grade barn	107 60	
Horse barn	21 05	
Dairy barn	450 30	
Feed	654 00	
Field crops	996 00	
Miscellaneous	38 35	
Meat house	120 85	
Farm house equipment	32 70	
Office	705 92	
Office books and library	1,347 03	
Dairy	991 75	
Poultry department	1,070 17	
		21,047 00
Horticultural Department—		
Tools	$141 55	
Heavy tools	540 50	
Teams, harness, etc	323 60	
Grafting and pruning tools, etc	61 75	
Tools in laboratory	22 45	
Animals in Zoo	128 00	
Spraying outfit	300 05	
Class room	491 54	
Laboratory equipment	279 15	
Office fixtures	2,473 12	
Greenhouse tools	282 95	
Greenhouse plants	1,646 90	
Miscellaneous	429 87	
		7,121 43
Department of Mathematics and Civil Engineering—		
Surveying instruments	$4,840 20	
Photographic material	58 25	
Tools and apparatus	1,246 94	
Class rooms	235 50	
Office furniture	440 95	
Engineering class room	157 55	
Astronomical laboratory	838 50	
Books and pamphlets	91 07	
		7,908 96
Mechanical Department—		
Office and class room fixtures	$2,807 79	
Experimental laboratory instruments	2,287 74	
Experimental laboratory apparatus	3,145 45	
Drawing and mathematical instruments	177 47	
Iron-working machinery	5,228 70	
Small iron-working tools	1,768 65	
Wood-working machinery	1,296 70	
Small wood-working tools	806 02	
Forge shop	747 13	
Foundry	612 18	
Belting, pulleys, shafting, etc	362 48	
Amount carried forward		$701,460 54

Amount brought forward		$701,460 54
Mechanical Department—Continued:		
Office supplies and stock	$408 35	
Sundry supplies	200 04	
Machine shop, stock	1,094 04	
Foundry, stock	393 50	
Wood shop, stock	338 90	
Forge shop, stock	59 05	
		21,734 19
Department of Physics—		
Office and shop	$982 49	
Mechanics	814 10	
Heat	381 85	
Sound	195 00	
Light	1,159 25	
Dynamic electricity	4,317 69	
Static electricity	1,012 50	
		8,862 88
Women's Department—		
Furniture, musical instruments, etc	$5,364 60	
Cooking school	636 16	
Wood-working room	405 76	
Domestic art	488 21	
Library	89 60	
Offices	130 15	
Miscellaneous	109 63	
Gymnasium	710 26	
		7,934 37
Department of Zoology and Geology—		
General museum	$18,091 75	
Furniture and general apparatus	1,297 80	
Tools	24 25	
Dissecting instruments	81 31	
Drawing instruments	12 75	
Microscopes	1,240 87	
Miscellaneous	705 41	
		21,454 14
Carpenter shop		887 76
Drawing Department—Furniture and equipment		2,385 89
English Department—Furniture and equipment		319 00
Forestry Department—Furniture, tools, etc		1,122 73
Department of History and Economics		215 00
Library		48,921 83
Military Department		777 60
Physical Culture and Athletics		661 45
President's Office		648 25
Secretary's Office		1,973 44
Veterinary Department—Apparatus and equipment		1,659 95
Hospital		269 96
Farmers' Institutes		579 75
Board Rooms		270 55
Postoffice		281 65
Weather Bureau		1,774 87
Miscellaneous		597 72
Cleaning supplies		270 90
Furniture in Chapel		342 30
Paint shop		484 15
Special Courses		2,075 97
Office State Inspector of Nurseries		109 55
Total		$860,869 85

SUMMARY OF EXPERIMENT STATION INVENTORY.

Lands donated to the Station—		
80 acres at Grayling, fenced and improved at cost....	$1,000 00	
5 acres at South Haven, fenced and improved.......	1,000 00	
160 acres at Chatham, including buildings...........	4,000 00	
		$6,000 00
Buildings—		
Bacteriological stable............................	$3,700 00	
Experiment station feed barn......................	800 00	
Veterinary laboratory, experimental rooms...........	250 00	
House..	1,000 00	
Station Terrace building..........................	3,000 00	
Seed room...	500 00	
Slaughter house...................................	625 00	
Storage barn......................................	600 00	
		10,475 00
Bacteriological Department—		
Apparatus...	$2,058 08	
Chemicals...	684 17	
Office..	36 00	
Library...	870 00	
		3,648 25
Botanical Department—		
Office..	$322 21	
Books...	35 10	
Apparatus...	390 86	
Glassware...	24 51	
Sundry..	16 13	
		788 81
Chemical Department—		
Platinum ware.....................................	$357 26	
Porcelain ware....................................	59 72	
Chemicals...	227 48	
Apparatus...	1,297 40	
Glassware...	447 99	
		2,389 85
Entomological Department—		
Office equipment..................................	$884 67	
Apparatus...	587 19	
Supplies..	41 44	
Chemicals...	49 32	
Glassware...	103 74	
Books...	236 86	
Spraying equipment................................	85 57	
Miscellaneous.....................................	78 60	
		2,067 39
Farm Department—		
Tools and equipment...............................	$993 85	
Office..	327 90	
		1,321 75
Horticultural Department..		529 70
Secretary's Office..		169 13
Library...		3,810 50
South Haven Station, equipment..................................		307 64
Upper Peninsula Station, equipment..............................		1,285 44
Total...		$32,793 46

DEPARTMENT REPORTS.

REPORT OF THE PRESIDENT.

To the Honorable State Board of Agriculture:

Gentlemen: I take pleasure in submitting herewith my report as President of the college under your care for the year ending June 30, 1907.

The year's work has been one of marked success. A cordial and helpful feeling existed among faculty and students, and all worked together in a harmonious and friendly spirit.

There has been a gain during the past year of about fifty in attendance. The total enrollment for the year was over one thousand. The usual statistics for the entering class are as follows:

Students entering during the year, not including those in special short courses.

Items.	Men.	Women.	Totals.
Number entering	257	67	324
Average age	19.3	20.2	19.7
Schools previously attended:			
High school	190	48	238
District school	23	4	27
College	30	8	38
State Normal	10	6	16
Private school	3	1	4
Entered College on:			
High school diploma	98	29	127
Eighth grade diploma	53	8	61
Teacher's certificate	3	5	8
Tenth grade standings	43	15	58
College standings	17	3	20
State Normal standings	3	3	6
Private school standings	4	2	6
Examination	25	....	25
Age	10	2	12
Support while here:			
Parents	127	45	162
Self	79	15	94
Parents and self	26	4	30
Guardian	5	2	7
Other sources	19	1	20
Occupation of father:			
Banker	3	1	4
Carpenter	2	....	2
Clergyman	3	....	3
Contractor	3	3	6
Deceased	21	12	33
Druggist	2	2	4
Editor	2	1	3
Engineer (mechanical)	4	0	4
Engineer (civil)	....	....	....
Farmer	75	14	89
Lawyer	4	4	8
Lumberer	6	2	8
Manufacturer	17	5	22
Mechanic	15	1	16
Merchant	44	8	52
Miller	1	....	1
Mining	3	....	3
Miscellaneous	27	10	37
Not given	2	....	2
Physician	4	....	4
Railroad employe	8	....	8
Real estate	6	1	7
Teacher	4	3	7
Proposed occupation after leaving college:			
Chemist	9	....	9
Engineer (agricultural)	....	....	....
Engineer (civil)	19	....	19
Engineer (electrical)	40	....	40
Engineer (mechanical)	78	....	78
Engineer (mining)	2	....	2
Farmer	43	....	43
Forester	16	....	16
Horticulturist	....	....	....
Mechanic	1	....	1
Miscellaneous	6	6	12
Teacher	1	27	28
Uncertain	51	34	85

Church membership.

Denominations.	Members.	Preference.	Total.
Advent	2	....	2
Baptist	12	19	31
Church of Christ	2	2	4
Church of Christ, Scientist	....	2	2
Congregational	20	32	52
Disciples	....	1	1
Episcopal	16	4	20
Jewish	1	3	4
Lutheran	4	5	9
Methodist Episcopal	44	31	75
Methodist Protestant	....	1	1
No preference	....	....	46
Presbyterian	23	27	50
Presbyterian (United)	1	....	1
Roman Catholic	14	....	14
St. Paul's Reformed	3	1	4
United Brethren	....	1	1
Unitarian	....	2	2
Universalist	1	3	4
United Christian	2	3	5

Counties represented in entering class.

Alpena	1	Kent	21
Allegan	9	Lapeer	1
Arenac	2	Lenawee	11
Baraga	1	Livingston	3
Barry	4	Mackinac	1
Bay	6	Macomb	4
Berrien	7	Marquette	2
Branch	3	Mason	1
Calhoun	4	Mecosta	3
Cass	1	Menominee	1
Charlevoix	4	Midland	1
Cheboygan	1	Missaukee	1
Chippewa	3	Monroe	1
Clare	1	Montcalm	7
Clinton	1	Oakland	4
Eaton	16	Oceana	3
Emmet	2	Ontonagon	1
Genesee	7	Osceola	4
Grand Traverse	2	Otsego	1
Gladwin	1	Ottawa	3
Gogebic	1	Sanilac	1
Gratiot	1	Saginaw	3
Houghton	2	Schoolcraft	3
Huron	1	Shiawassee	6
Ingham	54	St. Clair	6
Ionia	4	St. Joseph	6
Iosco	3	Tuscola	5
Isabella	1	Van Buren	3
Jackson	5	Wayne	15
Kalkaska	1	Washtenaw	5
Kalamazoo	5	Wexford	4

Other states represented.

Japan	1	New York	2
California	4	Ohio	5
Colorado	1	Pennsylvania	5
Florida	2	South Dakota	1
Illinois	6	Vermont	1
Indiana	1	Wisconsin	3

Summary of enrollment during the past year.

	General Agric'l.	Cream-ery.	Fruit.	Cheese.	Engineer-ing.	Agricultural	Engineer-ing.	Woman's.	Forestry.	Totals.
Post Graduates						2	......	3	......	5
Class of '07						38	54	18	5	115
Class of '08						32	42	19	3	96
Class of '09						37	85	25	3	150
Class of '10						74	113	34	......	221
Sub-Freshmen						55	71	14	......	140
Special Students						14	14	48	......	76
Special Course Students	119	42	18	19	5	198	5	......	......	203
Totals						450	384	161	11	1006
Deduct names repeated						......	......	......	......	5
Final total						......	......	......	......	1001

The senior class was graduated in connection with the jubilee exercises. The baccalaureate sermon and address to class will be found among the printed addresses of that occasion. The following persons were graduated with the degree of Bachelor of Science:

Name.	Postoffice.	County.
Allen, Will B., *e*	Jackson	Jackson.
Andrews, Helen W., *w*	Williamston	Ingham.
Angell, Anna M., *w*	Agricultural College	Ingham.
Angell, Ira D., *e*	Agricultural College	Ingham.
Ashley, Helen M., *w*	Davison	Genesee.
Bailey, Eva, *w*	Lansing	Ingham.
Baker, Julius L., *a*	Lansing	Ingham.
Beckwith, Herbert R., *a*	Howell	Livingston.
Benham, Rachel, *w*	Milford	Oakland.
Boulard, Ezra N., *a*	Alto	Kent.
Brass, Leroy C., *e*	Bridgeport	Saginaw.
Brown, George A., *a*	Agricultural College	Ingham.
Brown, Harry L., *a*	Agricultural College	Ingham.
Burley, George A., *e*	Harbor Beach	Huron.
Button, Jay C., *a*	Farmington	Oakland.
Cade, Claude M., *e*	Capac	St. Clair.
Campbell, Birum G., *e*	Parma	Jackson.
Canfield, Russell S., *e*	Lansing	Ingham.
Carpenter, Albert J., *e*	Schoolcraft	Kalamazoo.
Clise, Burton B., *a*	Bath	Clinton.
Craig, Myrtle, *w*	Lansing	Ingham.
DeLange, William W., *e*	Sparta	Kent.
Delzell, Ruth E., *w*	Bay City	Bay.
Dorland, LeRoy, *f*	Juda	WISCONSIN.
Doty, S. Wirt, *a*	Lockport	NEW YORK.
Dudley, Gordon C., *e*	Grand Rapids	Kent.
Ellis, Daniel H., *a*	Bridgeport	Saginaw.
Ellis, G. Henry, *e*	Flushing	St. Clair.
Fowler, Ernest C., *a*	Hanover	Jackson.
Gasser, Wilbert W., *e*	Sherman	Wexford.
Glazier, Hugh I., *e*	Whitehall	Muskegon.
Goetz, Christian H., *f*	Agricultural College	Ingham.
Goldsmith, Dayton R., *e*	Hanover	Jackson.
Goldsmith, Philip V., *a*	Jackson	Jackson.
Gould, Fletcher A., *e*	Owosso	Shiawassee.
Granger, Christopher M., *f*	Pasadena	CALIFORNIA.
Gregg, Orestes I., *a*	Canandaigua	NEW YORK.
Grover, E. Lynn, *a*	Kalamazoo	Kalamazoo.
Hart, Walter L., *a*	Albion	Calhoun.
Hayden, Leroy N., *e*	Kendall	Van Buren.
Hayes, Glenn B., *e*	Milford	Oakland.
Heinrich, G. Arthur, *e*	East Tawas	Iosco.
Hitchcock, Lytton B., *e*	Jackson	Jackson.
Hitchcock, Warren W., *e*	Hart	Oceana.
Hudson, Ralph S., *a*	Okemos	Ingham.
Johnson, Maurice F., *e*	Milo	Barry.
Johnson, Wilmer E., *e*	Lansing	Ingham.
Kinney, Inez M., *w*	Lansing	Ingham.
Kramer, Herman T., *e*	Detroit	Wayne.
Kratz, Oscar A., *e*	Albion	Calhoun.
Kraus, Ezra J., *a*	Lansing	Ingham.
Krental, Calla L., *w*	Agricultural College	Ingham.
Lilly, Scott B., *e*	Petoskey	Emmet.
Liverance, Wallace B., *a*	Lansing	Ingham.
Martin, L. Belle., *w*	Agricultural College	Ingham.
McHatton, Thomas H., *a*	Macon	GEORGIA.
McNaughton, Charles P., *a*	Middleville	Barry.
Miller, Violet, *w*	Lansing	Ingham.
Minard, Ray F., *e*	Imlay City	Lapeer.
Moomaw, Dalton, *e*	South Bend	INDIANA.
Myers, J. Lindsay, *e*	Shelby	Oceana.
Palacio, Alfonso G., *a*	Durango	MEXICO.
Parsons, Ivan E.,	Grand Blanc	Genesee.
Peck, Clair B., *e*	Belding	Ionia.
Pennell, Ray L., *a*	Berrien Springs	Berrien.
Perry, Neal C., *a*	Elk Rapids	Antrim.
Piper, William E., *e*	Agricultural College	Ingham.
Pokorney, Ida, Mrs., *w*	Agricultural College	Ingham.
Post, Otice C., *e*	Lowell	Kent.
Pratt, A. Crossman, *e*	Lansing	Ingham.
Rinkle, Lorin G., *a*	Dimondale	Eaton.

Name.	Postoffice.	County.
Robinson, Earl P., *a*	St. Louis.	Gratiot.
Roby, Edith, *w*	Haslett	Ingham.
Rounds, Florence, *w*	Berlin	WISCONSIN.
Rowe, Clifford F., *e*	Milford	Oakland.
Seiler, Rudolph, *e*	Detroit	Wayne.
Shuttleworth, Paul H., *a*	Lansing	Ingham.
Smith, Guy W., *a*	Kalamazoo	Kalamazoo.
Smith, Lyle F., *e*	Sparta	Kent.
Stewart, Burt C., *e*	Pittsford	Hillsdale.
Stone, Harry G., *a*	Medina	Lenawee.
Taylor, Ernest H., *e*	Oxford	Oakland.
Thatcher, Fent E. N., *e*	Ravenna	Muskegon.
Town, Earle A.,	Geneva	Lenawee.
Towner, Alonzo A.,*a*	Perry	Shiawassee.
VanAlstine, Ernest, *a*	Lansing	Ingham..
Van Halteren, Andrew S., *e*	Lansing	Ingham.
Verran, Garfield, *e*	Republic	Marquette.
Waite, Roy H., *a*	Brown City	Lapeer.
Warden, Walter, *a*	Rushton	Livingston.
Weeks, Harold B., *a*	Albion	Calhoun.
White, Oliver K., *a*	Hart	Oceana.
Wilcox, John C., *a*	Lansing	Ingham.
Willson, Edwin A., *a*	Bozeman	MONTANA.
Wilson, Arthur W., *e*	Detroit	Wayne.
Wright, Lee H., *e*	Detroit	Wayne.

IMPROVEMENTS.

The Engineering Building begun last year will be completed, equipped and ready for occupancy by the opening of the next school year. A description of the building can be found in my last annual report.

A new horse barn was erected during the past year at a cost of something over four thousand dollars. The old piggery was removed to a less conspicuous location and repaired. Our barns, while not of an expensive nor extravagant character, now present a very creditable appearance. They are conveniently arranged and up to date.

A stone road fifteen feet in width has been constructed from the township line road, north of college, to the city limits. The college took the initiative, but after part of the money was raised by subscription, turned the project over to the Business Men's Association of Lansing. The contract price for grading, material and construction was $12,800. The college, by agreement, paid twenty per cent. of the entire cost. The state paid one thousand dollars per mile, and the balance was paid by subscription; the owners of abutting property contributing liberally. The distance is a few feet over two miles.

NEW AGRICULTURAL BUILDING.

The board decided a few months ago to erect at once a building for the agricultural department. Plans are being prepared by E. A. Bowd, the college architect. The contract will be let and the building well under way this fall. This building will be the most expensive yet erected upon the campus and will cost not less than one hundred twenty-five thousand dollars. It will occupy the site at the southeastern corner of the campus formerly occupied by the original barns.

CHANGES IN THE FACULTY.

The vacancy caused at the close of last year by the resignation of Dr. Edwards, the head of the department of English and Modern Lan-

guages, was filled by the election of Thomas C. Blaisdell, A. M., Ph. D., of Pittsburgh, Pa. Dr. Blaisdell bids fair to prove a very worthy successor to the distinguished men who have filled this position in the past.

A few days before the opening of the college year Professor Charles L. Weil resigned his position as professor of mechanical engineering and director of the mechanical laboratory. Professor Sawyer, in connection with his duties as professor of physics and electrical engineering, very kindly took charge temporarily. As it was difficult to draw a good man away from his work during the college term, this arrangement continued until the end of the year, at which time all the engineering work was organized into one department, and Professor George W. Bissell, of Ames Iowa, was placed in charge as dean. Professor Bissel is a graduate of Cornell University and, in addition to considerable practical experience, has filled very successfully the position of professor of mechanical engineering in the Iowa State College for the past sixteen years. With all the engineering work centered in the new building; with large additions to laboratory space and equipment, this department enters, we believe, upon a new era of service. It is not the intention to take up new lines of work, but rather to do a high grade of work mainly along those lines which have been followed by this institution in the past.

The college regrets to have lost the services of Professor Weil. The Mechanical engineering department, of which he was in charge for thirteen years, developed and became prominent under his control. He brought to his work a high degree of scholarship, a keen insight into practical affairs, and untiring energy. His ability as an engineer brought to him so many opportunities for outside work that he finally felt called upon to relinquish his connection with the college and give all his time to professional work.

The college also regrets to lose the services of Dr. G. A. Waterman, who has been in charge of the veterinary department for the past ten years. Dr. Waterman graduated from this college with the class of '91. After completing a course in the Chicago Veterinary College, he held the professorship of veterinary science in Storrs Agricultural College, Connecticut, until he was called to the position in this institution. Dr. Waterman was an enthusiastic, successful teacher, and is held in the highest esteem by all those who came under his instruction. He also rendered very valuable service to the college outside of his department. He shirked no responsibility, however arduous and unpleasant, and gave much time and energy to furthering the students' interests along religious and social lines. However, he did not wish to grow old in the teaching profession, and having a strong desire to take up the active duties of the farm, resigned his professorship to accept the management of a valuable farm near Ann Arbor, which is owned and controlled by a company of which he and his family are the principal stockholders.

CHANGES IN COURSE OF STUDY.

For several years the faculty has had under consideration certain changes in the agricultural and women's courses. It was felt that with the rapidly broadening field of knowledge in agriculture and home economics, a greater opportunity should be given for elective work during

the junior and senior years. In the new courses, the schedule of studies up to the junior year is fixed and must be followed as outlined. A minimum of technical work for the junior and senior years is also required. The balance of the work during the last two years is elective.

LEGISLATION.

The legislature, during its last session, passed several acts of interest to the college.

By joint resolution it authorized the State Board to expend not to exceed eight thousand dollars in celebrating the fiftieth anniversary of the institution.

It authorized the State Board of Agriculture to establish, when it deems advisable, a veterinary college.

It set apart, as a permanent forestry reservation, about forty-two thousand acres of college lands located in Oscoda and Alcona counties.

Best of all, it removed the one hundred thousand dollar limit on the one-tenth mill tax. In the future, or until the law is repealed by the legislature, the college will receive a one-tenth of a mill tax annually. At the present valuation, this amounts to about one hundred seventy-three thousand dollars each year.

The federal government also passed a law known as the "Nelson amendment," which gave to the college this year five thousand dollars. This sum will be increased each year until the maximum amount—twenty-five thousand dollars—is reached. It will remain at this sum, and will be equivalent to the interest on an endowment of half a million dollars at five per cent.

THE OUTLOOK.

It may be said that the college, for the first time in its history, is on a sound financial basis. Of course as the college develops, a greater income will be necessary, but at present the income seems commensurate with its necessary needs, with a sufficient margin to provide for considerable addition in the way of buildings within the next few years.

We must have as soon as possible a large greenhouse for the horticultural department; an addition to the botanical building; a new library building; an auditorium; a gymnasium; another wing to the women's building, etc.

THE JUBILEE.

For several years all those connected with the college looked forward with considerable interest to the celebration of the semi-centennial. The triennial reunion of the alumni should have been held last year, but it was postponed one year in order that it might be held in connection with this celebration. Plans were discussed from time to time, but not until the beginning of the school year was active work begun. It was early suggested that possibly President Roosevelt might be induced to honor the jubilee of this college with his presence. The matter was taken up quietly. Later the Honorable C. J. Monroe attended the meeting of the M. A. C. alumni in Washington, and while there visited the President and extended to him an invitation to be present. The Governor, Fred M. Warner, and Deputy Food Commissioner, Colon

C. Lillie, when in Washington called on the President and urged him to come to Michigan.

On Arpil 12th, 1906, the State Board passed a resolution inviting him to be present, and instructed the president of the college to present the invitation to President Roosevelt in person. Accompanied by Senator Burrows, Congressman Gardner and Professor Curtiss, I delivered the invitation of the board and faculty to the President on April 18th. The appointment for this meeting had been made by our representative in Congress, the Honorable S. W. Smith, who could not be present on account of another engagement. I also presented letters from the master of the State Grange, the president of the State Association of Farmers' Clubs, and the secretary of the State Horticultural Society, requesting his presence on this occasion. Professor C. F. Curtiss, of Iowa, as a representative of the executive committee of the American Association of Agricultural Colleges and Experiment Stations, assured him that if he would come to Michigan all the other agricultural and mechanical colleges of the country would send delegates to meet him here and would not press him with invitations to visit other institutions. Finally the President stated that it was his desire to make one address to the farmers of this country while he was in office, and probably this would be the proper occasion. In a few weeks his secretary opened communication with me as to the arrangement of date, and the press dispatcher from the White House stated that the President had decided to speak at the semi-centennial celebration of the Michigan Agricultural College.

It had been rather conceded for several years that the American Association of Agricultural Colleges and Experiment Stations would hold its annual meeting in connection with this celebration. The date and place of meeting being left to the executive committee, of which I have had the honor to be a member during the past five years, met in Lansing early in December to satisfy itself as to the ability of Lansing to take care of such a meeting. The Downey House, which had been rebuilt during the year, was at its best. It promised to turn over one hundred and forty of its best rooms for the exclusive use of the members of this association. The committee decided to hold the annual meeting in Lansing during the early part of the week of our jubilee. It also was agreed to hold Thursday morning's session at the college, and make it a part of the jubilee exercises.

As the college had no authority to spend money in preparing for such a celebration, the legislature came to its relief and passed a joint resolution permitting the State Board to spend not to exceed eight thousand dollars from college funds in making preparations for the coming jubilee.

The State Board turned the entire matter over to the faculty with no instructions except to make the most of the money set apart for this purpose.

Early in the school year the president of the college appointed a committee to have general charge of the celebration with power to appoint such sub-committees as might be found necessary. This committee consisted of Profesor Warren Babcock, chairman; Professor Frank S. Kedzie, Professor R. S. Shaw, Instructor Thomas Gunson and A. M. Brown, the secretary of the college.

On the assumption that funds would be provided, the committee early ordered invitations from Tiffany, New York. These consisted of two forms, one for individuals and the other for institutions, organizations, etc. These were mailed to all alumni and former students whose post-office addresses, by persistent and painstaking efforts, had been secured during the past year, to the prominent citizens of the State, and to other educational institutions and learned societies of this country, and a few to similar institutions and organizations in foreign lands.

The exact date of the anniversary is May 13th, but this date seemed too early for convenience and comfort, hence the committee decided on the last week of May as the best suited for this occasion. It was necessary to place the date sufficiently late to assure comfort, and early enough to avoid conflict with the commencement exercises of the other colleges, which would desire to send delegates.

The committee decided to hold the regular baccalaureate service on the preceding Sunday, and to graduate the senior class at the closing session of the exercises. The celebration was to extend through three days—Wednesday, Thursday and Friday. The first session was to be known as a state meeting. The Governor of the State and representatives of the various organizations of farmers, engineers and state institutions were to speak. The afternoon meeting was to be held in honor of the memory of the builders of the college. On Wednesday evening was to take place the musical event of the week—the rendering by the college chorus of Hayden's great oratorio, the Elijah. Thursday morning was to be held in conjunction with the American Association of Agricultural Colleges and Experiment Stations, and was to be devoted to a summing up of the educational and investigation work done by the land grant colleges during the last half century.

The alumni banquet was to be held at one o'clock, after which the regular literary program of the alumni triennial meeting was to be rendered.

As this was Decoration Day, it was deemed eminently proper to have a short dress parade by the battalion at four o'clock, to be followed by an address by a prominent ex-soldier.

On Thursday evening was to be held the students' parade, the illumination of the campus, and the public reception. On Friday forenoon a jubilee meeting at which representatives of the different sections of the country were to speak, and at two o'clock in the afternoon President Roosevelt was to speak, after which the conferring of degrees of the graduating class and a few honored guests was to take place. Society reunions and banquets were given Friday evening.

The baccalaureate sermon was given by the venerable Dr. Buckham, president of Vermont University. Five of the Lansing ministers were present and assisted in the exercises. The Armory was used for this occasion, and was filled with faculty, students and visitors. The sermon was a very carefully prepared and strong address. It will, as well as the other addresses of the jubilee, be found in the memorial volume.

During Monday and Tuesday many delegates and alumni arrived. The weather was far from reassuring. The season was exceedingly late. The leaves on the maples and elms were not half developed; the oak buds were not larger than the proverbial "squirrel ear" size. Furnace fires were continuously in use until this week, and rains were of almost daily occurrence.

Wednesday morning opened bright and warm, and kind nature vouchsafed three days of good weather—the first three days of continuous fine weather during the spring to this date.

Promptly at ten o'clock the president of the college called the meeting to order. All the speakers on the programme were present. A number of the orators spoke without manuscript. The meeting was large and enthusiastic.

At two o'clock another large and enthusiastic meeting was held in the Armory. The older alumni especially seemed to enjoy this meeting. After this meeting a large number of the alumni and other visitors repaired to the athletic field to witness a ball game between our college team and the Michigan University nine. The game resulted in a score of two to one in favor of the U. of M.

About twenty-five hundred people assembled in the large tent at eight o'clock to hear the rendition by the college chorus of the "Elijah." The soloists pleased the audience and every member of the college was proud of the finely trained chorus. The Bach Orchestra fully maintained its great reputation. Unstinted praise was heard on all sides of the evening's entertainment.

The Thursday morning meeting was held in conjunction with the Association of Agricultural Colleges and Experiment Stations. The large tent was well filled and the meeting was all that could be desired.

At eleven o'clock the alumni held an enthusiastic meeting in college hall. Immediately after the morning meeting the large tent was prepared for the alumni dinner. A second tent had been erected adjacent to the large tent. Preparations for the banquet were made in this tent. The chairs were partially removed from the large tent and poles eight feet in length, upon the upper end of which were card boards designating classes by year, were stuck in the ground throughout the tent. A sufficient number of chairs were grouped around each class pole to accommodate members of said class and friends present. Each of the twelve hundred present found his place readily. The curtain between the tents was removed, and the great body of student waiters—fifty or more—served this large assembly quickly and without the least confusion. Nothing in connection with the jubilee exercises was conducted with greater satisfaction to all concerned than was the serving of this alumni dinner.

It is impossible, of course, to describe the cordial friendship and exhuberance of good feeling manifested on such an occasion. It can come but a few times in the life of any individual.

A literary program followed the banquet, and at four o'clock the battalion, in charge of Captain Füger, gave a dress parade drill on the athletic field. A large audience gathered in the tent after the drill to hear the memorial address given by the Honorable Washington Gardner. This address was well received.

Considerable effort had been put forth in preparing for the illumination of the campus. The new lighting system afforded an abundance of electric current. The Women's Building, the Library, Williams Hall, College Hall, the new Engineering Building and Abbot Hall were specially wired for this occasion. Rows of incandescent lights were run along the tops and edges of the roofs, down the corners, and on all projections, until the buildings fairly glowed. Wires were stretched the

entire length of faculty row, and at various other points on the campus on which were hung every few feet Japanese lanterns lighted with electric bulbs.

The young men, about five hundred in number, assembled near Wells Hall. They were prepared each with a torch light, white cap, long white cape and white leggins. With the cadet band, they marched the campus singing college songs and forming various figures and designs. They finally formed a hollow square in front of the Women's Building. The young women then came from this building and gave a fancy march known as "The Oak Chain." The band played; college songs and college and class yells rent the air. They marched to the open campus in front of Wells, where huge bonfires were lighted. Alumni and students joined in songs and hilarity. Months beforehand there had been printed a booklet of college songs and students had met frequently in the Armory for practice in singing. A number of jubilee songs were written for this occasion. One of the most popular was written by Mr. A. M. Brown, the secretary of the college, and is herewith printed.

Close beside the winding Cedar's
  Sloping banks of green
Spreads thy campus, Alma Mater,
  Fairest ever seen.

Chorus—
    Swell the chorus! Let it echo
      Over hill and vale;
    Hail to thee, our loving mother,
      M. A. C., all hail.

First of all thy race, fond mother,
  Thus we greet thee now,
While with loving hands the laurel
  Twine we o'er thy brow.

Backward through the hazy distance
  Troop the days of yore,
Scenes and faces float before us,
  Cherished more and more.

College Hall and Wells and Williams,
  Abbot and the rest,
Halcyon days were those spent with you,
  Days of all the best.

Fold us fondly to your bosom,
  Alma Mater, dear,
Sing we now thy endless praises,
  Sounding cheer on cheer.

At nine o'clock the Armory and large tent was aglow with electric lights in anticipation of the public reception. The receiving line consisted of the president of the college and Mrs. Snyder, Governor and Mrs. Fred M. Warner, President Angell, of the university, and the Honorable C. J. Monroe, president of the State Board, and Mrs. Monroe. This reception was largely attended by delegates and alumni. The Bach Orchestra rendered a fine musical programme in the large tent. This afforded a fine entertainment, especially for students and visitors from Lansing.

Friday morning opened bright and clear with every promise of fine weather. The procession, consisting of delegates, alumni, faculty and students, marched from the Library to the large tent. Delegates expecting to present congratulatory addresses were seated at the left of the platform.

After the opening exercises, consisting of music and prayer, the reception of addresses was announced by Professor Clinton D. Smith, who stood on the left end of the platform. As a delegate ascended the steps to the platform, presented his card to Professor Smith, who announced to the audience the name of the delegate, his position, and the institution which he represented. The delegate would then walk across the stage, present his parchment or letters to the president of the college and be shown to a seat on the platform. This exercise created a great deal of interest, and many of the more distinguished delegates called forth applause.

The meeting was now placed in charge of the president of the State Board, the Honorable C. J. Monroe. The programme was one of rare merit. President James, who was unable to be present, was represented by Dean Eugene Davenport, who read the address prepared by President James. This was the only instance during the entire exercises of the absence of a speaker. It is needless to say that the audience was large and enthusiastic.

Everybody looked forward to the Friday afternoon meeting as the climax of the jubilee exercises. In anticipation of good weather and a great crowd, a platform had been erected overlooking the open space of ground southeast of the president's house. This platform was south of the road and west of the large elm. It was fifteen by thirty feet, with a projection on the front of ten by six feet. This projection was covered with a canopy. The space in front of the platform was roped off and contained seating capacity for thirty-five hundred. Admittance to this enclosure was by ticket.

President Roosevelt and his party arrived in Lansing at ten o'clock by the Lake Shore. The reception committee had been arranged by the president of the college, and consisted of the United States Senators, the Governor, the Mayor of the city, a member of the Supreme Court, two members of the State Senate, three members of the House, and the vice-president of the State Board and the president of the College.

The citizens of Lansing took great interest, not only in the visit of the President, but in the entire jubilee exercises, and rendered very valuable assistance. The city was prettily decorated. Carriages conveyed the party from the station to the Capitol, the Governor and the Mayor of the city riding with the President, and the state militia, with several companies of cavalry, serving as an escort.

Upon arriving at the Capitol the President held a brief reception in the Governor's parlors for the state officials and members of the legislature. He then spoke a few words from the balcony to the large crowd on the front lawn, after which he was escorted to the assembly room, where he spoke for fifteen or twenty minutes to an audience made up of state officials, members of the legislature and their friends.

The trip from Lansing to the college was made in automobiles. The Reo Company furnished ten cars to transport the president's party and special guests to the college, and the Olds Company a like number for

the return trip. On the outward trip Mr. R. E. Olds drove the President's car. Beside him rode Mr. Loeb, the President's secretary, and on the rear seat was President Roosevelt and the president of the college. This car was preceded by one carrying the chief of the city police and several secret service men, four of whom accompanied the President on this trip. There were also, besides others, three correspondents representing the three principal news agencies.

A company of cavalry escorted the automobile from the Capitol to beyond the railroad. The trip was made to the college in a few minutes. The new macadam road had been thoroughly wet down by sprinklers during the previous night and early morning. Another company of cavalry was awaiting our arrival at the west entrance to the campus. A tour of the college grounds was made, following the main drive by way of the Armory, Williams Hall, Library and back along Faculty Row to the president's house. Immediately after the distinguished visitors had entered the building, the cavalry encircled the house and no one was permitted to come near unless he was properly vouched for.

The party arrived promptly at twelve o'clock. After a few minutes of introduction and handshaking, the sixty guests sat down to a five course luncheon. After dinner the battalion was drawn up in front of the president's residence, and as President Roosevelt came forth the cadets presented arms. The President acknowledged this with the accustomed military salute. The battalion then quickly formed two lines from the steps of the residence to the platform from which he was to speak. Between these lines the President and other guests marched to the platform, halting for a moment midway while the President planted a tree. This young elm was about an inch and a quarter in diameter and seven feet tall.

The audience was carefully controlled by four companies of militia. Faculty, students, alumni, former students, delegates, members of the legislature, State officials and invited guests were admitted within the ropes by ticket. The size of the audience was variously estimated at from twenty to twenty-five thousand people. The platform was occupied by the candidates for honorary degrees, the President's party, and a few distinguished citizens of Michigan. The President was given a hearty, cordial but dignified greeting by the audience. The meeting began promptly at the appointed time, two o'clock. The preliminary exercises were brief. The audience sang a national hymn, "Mendon;" the Rev. E. M. Lake led in a brief prayer, and the president of the college introduced the speaker in the following words: "Ladies and Gentlemen, the President of the United States, Theodore Roosevelt."

The address was delivered from a small manuscript printed in large type on one side of paper. The President held this in one hand and did not read closely, quite frequently gesticulating with both hands. He spoke quite slowly, in a high, penetrating tone of voice, and was heard by nearly all present. He was about one hour and fifteen minutes in delivering his address and held the closest attention of the audience throughout. When he had finished, the audience sang "America."

The bachelor's degree was conferred on the members of the senior class, ninety-six in number, and they were requested to come forward and receive their diplomas. They were happily surprised to receive

their parchments from the hand of President Roosevelt, who seemed delighted to do them this honor.

The following honorary degrees were then conferred by the President of the College:

The degree of Doctor of Science:

William Arnon Henry, dean of the College of Agriculture and director of the Experiment Station, Wisconsin University.

Charles Fay Wheeler, expert, Department of Agriculture, Washington, D. C.

Henry Clay White, president of the Agricultural College of Georgia.

Charles Franklin Curtiss, dean of Agriculture and director of Experiment Station, Iowa State College.

Thomas Forsyth Hunt, director of Experiment Station, Pennsylvania.

William Warner Tracy, expert in tertology, Washington.

Gifford Pinchot, chief forester of the Department of Agriculture, Washington.

The degree of Doctor of Laws:

James Burrill Angell, president of the Michigan University.

Eugene Davenport, dean of the Agricultural College and director of Experiment Station, University of Illinois.

Winthrop Ellsworth Stone, president of Purdue University.

Herbert Winslow Collingwood, editor of the *Rural New Yorker*.

Mortimer Elwyn Cooley, dean of the Engineering Department, Michigan University.

Whitman Howard Jordon, director of Geneva Experiment Station.

Enoch Albert Bryan, president of the Agricultural College of the State of Washington.

Rolla Clinton Carpenter, professor of Experimental Engineering, Cornell University.

James Wilson, secretary of agriculture, Washington.

The audience remained orderly and quiet during the closing exercises, and seemed very much interested in each person upon whom an honorary degree was conferred, breaking forth in applause as each took his seat. As Dr. Angell came forward the audience arose *en masse* and remained standing while he received his degree.

Somewhat to the surprise of those most interested, the granting of the honorary degrees on this occasion was solemn and dignified; the open platform and large assembly seemed to intensify the interest in the ceremony rather than detract from it, as was feared might be the case.

The audience was dismissed by the benediction. The President, his secretary and Congressman S. W. Smith occupying one automobile. This car was driven by Mr. Frederick Smith, one of the officials of the Olds Motor Car Company. The same number of cars were used as in the trip to the college, and in a few minutes the President was safely in his private car again at the Lake Shore station, greatly to the relief of those who, in a measure at least, felt responsible for his safe keeping.

This ended the jubilee proper. During the evening were held the reunions, banquets and parties of the various literary societies. Every available building, both at the college and in Lansing were used for this purpose and an exceptionally happy time was reported by all concerned.

The full programme of the week is herewith given:

SEMI-CENTENNIAL
OF
MICHIGAN AGRICULTURAL COLLEGE
1907.
THE COLLEGE AND THE STATE
WEDNESDAY MORNING
MAY TWENTY-NINTH AT TEN O'CLOCK
ASSEMBLY TENT

Address for the State—By His Excellency Fred Maltby Warner, Governor of Michigan.

Address for the Grange—By the Honorable George B. Horton, Master.

Light Cavalry Overture, Suppé—By the College Band.

Address for the Farmers' Clubs—By the Honorable Lucius Whitney Watkins, President.

Address for the Agricultural Society—By the Honorable Ira Howard Butterfield, Secretary.

Address for the Engineering Society—By Mr. Frank Hodgman, President.

Auf Wiedersehen, Bailey.

Address for the Normal Schools—By President Lewis Henry Jones, Ypsilanti Normal College.

Address for the Denominational Colleges—By Doctor August F. Bruske, President of Alma College.

Address for the State Board of Education—By the Honorable Luther L. Wright, Superintendent of Public Instruction of Michigan.

March Comique, Hall.

Wednesday, May twenty-ninth at two o'clock
The Builders of the College

Chicago Tribune March, Chambers—By the College Band.

Address, The College and the Students, '57-'60—By the Honorable Charles Jay Monroe, President of the State Board of Agriculture.

Address, Members of the Early Faculty—By Doctor Albert John Cook, Professor of Biology in Pomona College, Claremont, California.

Address, How They Taught in Early Days—By Doctor Charles Edwin Bessey, Dean of the Industrial College and Professor of Botany, University of Nebraska.

Cornet Solo, Schubert's Serenade—By Mr. A. J. Clark.

Address, The College in 1870—By Doctor William James Beal, Professor of Botany in this College since 1870.

Address, Early Members of the Board—By the Honorable Charles W. Garfield, Member of Board from 1887 to 1899.

Wednesday evening at eight o'clock
Mendelssohn's Oratorio—Elijah.

Soprano—Miss Lillian French Reed, Chicago.

Contralto—Miss Viola Paulus, Chicago.

Tenor—Mr. John Young, New York.
Basso—Doctor Carl Dufft, New York.
The Bach Orchestra of Milwaukee—Christopher Bach, Conductor.
College Chorus—Miss Louise Freyhofer, Director.

Thursday Morning at nine o'clock
Assembly Tent.

Open Session with the American Association of Agricultural Colleges and Experiment Stations—Professor Liberty Hyde Bailey, Director of the College of Agriculture of Cornell University, presiding.

Overture, If I were King, Adam—By the Bach Orchestra.

Development of Agricultural Education—By Doctor Elmer Ellsworth Brown, United States Commissioner of Education.

Development of Engineering Education—By Doctor Winthrop Ellsworth Stone, President of Purdue University.

La Feria from Los Toros, Lacome.

The Authority of Science—By Director William H. Jordan, of the Geneva, New York, Experiment Station.

Grand March, Christopher Bach.

Alumni Day Exercises

Alumni Business Meeting, eleven o'clock—College Chapel.
Alumni Luncheon, twelve o'clock—Assembly Tent.
Alumni Literary Exercises, two o'clock—Assembly Tent.
Class Reunions, five o'clock to eight o'clock—Various places.

Alumni Literary Exercises
Thursday Afternoon at two o'clock—Assembly Tent.

Overture, Light Cavalry, Suppé.
President's Address—By Mr. Russell Allen Clark '76.
Oration—By Mr. Ray Stannard Baker '89.
Cavatina, Raff.
Poem—By Mrs. Pearl Kedzie Plant '98.
History—By Mr. Charles Jay Monroe '61.
Fantasia from Il Trovatore, Verdi.
Necrology—By Mr. Herbert Windsor Mumford '91.

National Memorial Day
Thursday Afternoon at four o'clock—Assembly Tent.

Memorial Day Parade—By the College Battalion on Parade Ground adjoining Assembly Tent at four o'clock.

Musical Program—By College Band.

Memorial Day Exercises—Assembly Tent, at the close of the Battalion Parade.

Invocation—By Doctor Frank Gibson Ward.

Memorial Day Address—By the Honorable Washington Gardner, Member of Congress from the Third Michigan District.

Thursday Evening

Illumination of Campus at eight o'clock.

Parade by the Students with College Songs.

The "Oak Chain" Fancy March—By the Young Women of the College in front of the Women's Building; Bonfires in front of Wells Hall.

Reception to Delegates, Alumni and friends of the College—College Armory at nine o'clock.

Orchestra Concert in Assembly Tent adjoining College Armory from nine to eleven o'clock.

Friday Morning

May thirty-first at nine o'clock—Assembly Tent.

Procession of Delegates Alumni, Faculty and Students.

Invocation—By The Reverend Horace Cady Wilson, Lansing, Mich.

Reception of Congratulatory Addresses from other institutions and Learned Societies.

March, Badger State, Christopher Bach.

Polonaise from Mignon, Thomas.

Address for the Department of Agriculture—By the Honorable James Wilson, Secretary.

Address for Michigan and its University—By President James Burrill Angell, University of Michigan.

The Nightingale and Thrush, Bosquetto.

Address for the East—By President Rufus Whittaker Stimson, Connecticut Agricultural College.

Address for the South—By President Henry Clay White, College of Agriculture and Mechanic Arts, University of Georgia.

Solo for Cornet with Orchestra.

Address for the West—By President Benjamin Ide Wheeler, University of California.

Address for the Middle West—By President Edmund Janes James, University of Illinois.

Wedding March, Mendelssohn.

Jubilee Day

Friday Afternoon, May thirty-first at two o'clock.

March International, Lincoln.

Overture from Martha, Flotow.

Singing of Mendon—By the Audience.

MENDON.

Great God of Nations now to Thee
  Our hymn of gratitude we raise;
With humble heart and bending knee
  We offer Thee our song of praise.

Thy name we bless, Almighty God,
  For all the kindness Thou hast shown
To this fair land the pilgrims trod—
  This land we fondly call our own.

Here freedom spreads her banner wide,
  And casts her soft and hallowed ray;
Here Thou our fathers' steps didst guide
  In safety through their dangerous way.

We praise Thee that the gospel's light
  Through all our land its radiance sheds,
Dispels the shades of error's night,
  And heavenly blessings round us spreads.

Great God, preserve us in Thy fear;
  In danger still our Guardian be;
O spread Thy truth's bright precepts here;
  Let all the people worship Thee.

Invocation—By the Reverend Elisha Moore Lake.

Address—By Theodore Roosevelt, President of the United States.

Singing of America—By the Audience.

Conferring of Baccalaureate Degrees, Conferring of Honorary Degrees —By President Jonathan Le Moyne Snyder.

Overture from Cyrano, Christopher Bach.

Society Banquets and Reunions, Friday Evening, May thirty-first at seven o'clock.

The following committee and the work done by each is worthy of special notice:

The committee on invitations consisted of Professor Warren Babcock and Secretary A. M. Brown. Their work was taken in hand early in the year and a contract made with Tiffany of New York for the invitations.

Miss Louise Freyhofer, instructor in music, Professor Andrew J. Patton, chemist of the experiment station and Mr. Arthur J. Clark, instructor in chemistry constituted the committee on music. The college chorus, consisting of one hundred and fifty voices was under the direct charge of Miss Freyhofer. The soloists were selected by this committee and it was upon the recommendation of this committee that the Bach Orchestra of Milwaukee was employed.

Mass meetings were held during the year for the purpose of practicing college songs. Song books, containing a number of popular songs, were printed and given to the students. Mr. Patton and Mr. Clark conducted the singing at the mass meetings. The college band was also in training many months for this occasion.

Professor L. R. Taft, Professor A. R. Sawyer and Capt. Füger had charge of the tents, seating, etc. Three large tents were rented. The largest was two hundred by one hundred feet and adjoining this was a smaller one seventy by one hundred thirty feet in size. Another of the same size was used by the committee having in charge the matter of provisions. It was used for lunch counters, dining rooms, etc. A small tent for the use of the "press" was located on the south side of the parade ground. All four tents were located on the drill grounds; the largest one opposite the bath house. Chairs were imported from Detroit, Grand Rapids and Ionia and in addition the college made a large number of wooden benches. Had it been necessary to hold the Roosevelt meeting in the tents, there were enough seats available to accommodate between five and six thousand persons.

The committee, having supervision of concessions upon the campus and the feeding of visitors, consisted of Dr. C. E. Marshall and Instruc-

tors W. G. Sackett, J. J. Myers and F. O. Foster. This committee was very ably assisted by Miss Elizabeth Jones, Acting Dean of the Women's Department and Miss Louise Waugh, instructor in Domestic Science.

The committee decided to reject all petitions from outsiders for concessions upon the grounds and decided to provide nothing for the visitors other than the necessary meals and lunches. The committee established a Baltimore lunch counter in a tent upon the Campus, and also provided meals at moderate prices in the dining room in Wells Halls. The Boarding Club Associations also co-operated in furnishing meals. In addition provision was made to furnish fifty cent breakfasts and fifty cent dinners to delegates and such other individuals as might desire them in the Women's building on the second floor. A luncheon was served each day to delegates in the Women's gymnasium. The arrangements made by the committee were carried out very successfully.

The entertainment of delegates was in the hands of a committee, consisting of Professor F. S. Kedzie and Harry S. Reed. This committee was very ably assisted by Messrs. C. E. Bement and O. A. Jenison of the Lansing Business Men's Association. Mr. E. V. Chilson, secretary of the association also rendered very valuable service. He very kindly turned over the use of his office on Washington Ave., So., to the committee during Semi-Centennial week.

Cots were placed in the society rooms in Wells Hall and in two vacant houses near the college, and were gladly made use of by the "old boys." The Quarter-Master General very kindly loaned the college one hundred army blankets. A house to house canvass was made of the city and all available rooms scheduled. In this way it was possible to find comfortable accommodations for all visitors.

The committee on registration and badges was Professor H. K. Vedder, Professor J. A. Jeffery, Instructors S. C. Hadden, Harry S. Reed and Dr. Waterman. A very complete system of registration was devised by this committee. Very useful information concerning the alumni and former students was secured. The badges brought forth very favorable comment from delegates and alumni.

Seventy-five badges have been preserved and can be found in the strong box, containing souvenirs, programs, etc., of the Semi-Centennial occasion. These badges possibly may be worn at the Centennial celebration of the college by those who were present at the Jubilee.

The decorations and students' evening were in charge of a committee consisting of Director C. L. Brewer, Captain F. W. Füger, Instructor L. J. Smith, the college engineer, Mr. L. F. Newell and Miss Bessie Bemis. The decorations, in addition to the electrical display mentioned before in this report, consisted almost entirely of flags. A number of large flags were rented for this occasion, and were hung from the various buildings.

Dr. Geo. A. Waterman and Capt. Füger had charge of the Friday morning procession. This procession was formed in front of the Library Building and marched to the tent on the drill grounds.

The matter of academic dress was left optional and not being worn by the faculty of the college, only a few were so attired. The faculty seemed to feel that the character of this institution and of its alumni was such that it would perhaps be wise not to insist upon the academic dress on this occasion. It is very probable however, that were the

occasion to be repeated, the academic dress would be worn, especially upon this one occasion.

On account of the very large crowd, it was not deemed wise to have a full procession in the afternoon. However the faculty and senior class marched from the Women's Building to the place of meeting. Members of the legislature who were fortunate in reaching the Campus in time also formed as a body.

The printing of programs was in the hands of Dr. Thomas C. Blaisdell.

The alumni banquet was in charge of a committee consisting of two alumni, Professor J. D. Towar and Floyd W. Robison who, while not connected with the college, reside in the college neighborhood, also Secretary A. M. Brown, Instructors Miss Bessie Bemis and H. W. Norton.

Copies of invitations, programs and all printed matter which was used on this occasion together with photographs of the speakers, badges, newspapers, etc., have been placed in a strong box and stored away in a vault. Perhaps in future years they may be of interest to the college historian.

Agricultural College, Mich., June 30, 1907.

J. L. SNYDER,
President.

REPORT OF THE DEPARTMENT OF PRACTICAL AGRICULTURE.

To President J. L. Snyder:

The following is the report of the Agricultural Department for the year ending June 30, 1907.

DIVISION OF ANIMAL HUSBANDRY.

During the year the head of the department was assisted in the work by Instructors H. W. Norton and A. C. Anderson the teaching and demonstration work being about equally divided among the three. In addition to this, Mr. Norton has assumed a large part of the responsibility of the execution of the detail work of the beef, grade and scrub cattle experiments, compiling and preparing data for publication, and keeping up the registration of the pure bred herds; Mr. Anderson has assumed similar duties in connection with the pure bred and grade dairy herds, and swine, also. The following instruction work was given in this division, viz: for sub-freshmen and freshmen, study of breeds, fall term, 93 men, 5 hours per week for 12 weeks; for seniors and specials, advanced stock judging, fall term, 19 students, 10 hours per week for 10 weeks; for sophomores, animal breeding, winter term, 46 students 5 hours per week for 6 weeks; for juniors, animal feeding, spring term, 23 students 5 hours per week for 12 weeks; for seniors meat cutting, etc., winter term, 14 students 10 hours per week for 12 weeks. In the special short courses 90 first year students received instruction in stock judging 10 hours per week for 8 weeks, and 25

second year men in advanced stock judging 10 hours per week for the same length of time.

In my last report the progress of the work of removing and refitting the farm buildings was given; the work was continued throughout the year. The old horse barn, 38′x100′, was moved to a new location between the farm house and the dairy barn, about twenty yards south of the former; the ground floor of this was fitted up with an office for the farm foreman, wash room for men, work room and storage place for wagons, heavy wheeled implements, etc., the second floor was fitted for the storage of tools, the smaller implements, lumber, etc.; the elevator in the Agricultural building was removed to this structure, enlarged and installed. During the months of April and May the piggery, a structure 34′x80′, was moved south and west 100 yards or more to a point west of the sheep barn on the brow of a bank sloping toward the river; in the regrouping of the farm buildings, the piggery remained in front of them all, a very unsatisfactory place for it.

To accommodate one hundred head of experimental sheep 60 feet was added to the south end of the sheep barn, the plan of the new structure being made to conform to the old one.

The old beef cattle barn was placed up close to the silo at the south end of the dairy barn, and is being used as a protected exercising yard for cattle and a storage place for manure. Covered runways join this shed with the dairy barn on both sides of the silo.

A small milk house was constructed adjoining the dairy barn to make it possible to handle the milk in a more sanitary way, furnishing more perfect protection against flies and odors of the stable.

At the north end of the three sides of the square already enclosed by buildings, a new horse barn 48′x94′, was erected to accommodate 18 horses in stall, 5 box stalls, and also room for three carriages. A very full description of this building, as well as the remodeled ones, is to be given in bulletin form, the manuscript and illustrations for which are now ready.

Owing to the need of the original implement building, later used in part for a live stock class room, for farm mechanics work, it became necessary to refit the accommodation barn for the use of all classes in stock judging. The lighting of this building was increased and heat provided so that though somewhat cramped the work can be carried on here till the new agricultural building is completed.

An enormous amount of grading has been necessary in order to procure well drained yards. This grading work and that also entailed by the removal of buildings, is practically complete, the labor having been entirely preformed by men and teams of the department, as the relief from pressure of farm work gave opportunity.

In order to provide ample yardage for the numerous breeds of horses, cattle and sheep 2550 feet of yard fence was constructed. This fence consists mostly of five pieces of 2x6 inch hemlock spaced six inches apart and spiked to cedar posts eight feet apart. Wooden gates made out of 1x4 inch material with 1x6 inch at bottom are being universally installed, in fact all kinds of gates are being replaced by this style. The barn yards have been paved with cinders as far as they could be secured. The cinders are put on the graded surface of the earth, from six to nine inches thick, and then crushed by running the road roller over them

repeatedly. This makes an ideal yard bottom when well packed down. It will require the accumulation of cinders for another year to complete the paving of all yards.

This department has been engaged in a large amount of investigation work which is supported by funds from the experiment station, special live stock appropriation, and farm department. A list of publications issued during the past year is given in my report to the director of the experiment station.

Respectfully submitted,
R. S. SHAW,
Professor of Agriculture.

Agricultural College, June 30, 1907.

Prof. Jeffery reports the following from the division of agronomy:

The organization of the division and of its work has remained as it was reported a year ago, except that in some particulars the extent of the work has been enlarged.

Apparatus has been purchased which has made it possible to introduce laboratory practice into the soil work of the sub-freshman and freshman years.

Instruction was given to 93 regular students during the fall term, to 145 regular students and to 119 special students during the winter term, and to 88 regular students during the spring term.

Twenty-one days have been given by the head of the division to institute work, ten of which were spent with the special institute train.

Mr. Samuel Browning, an old and respected resident of the city of Detroit, died in that city some months since. During many years of his life he interested himself in the study of Indian corn and made a large collection of samples of corn. Many of these samples possess an especial value, both for their age and the sources from which they were gathered. Prior to his death Mr. Browning devoted much time to carefully cataloging his collection. At his death, by Mr. Browning's own direction, the whole collection was given to our department. As soon as room can be provided, the collection will be properly mounted, and it is anticipated it will prove not only of great interest, but of great value as well.

Mr. F. O. Foster reports the following from the dairy division.

The records of sales of dairy products, tests of cows in the college herds, and amount produced by those herds, has been turned in to the office of the farm department in daily, weekly and monthly reports, respectively.

Instruction was given to students in the regular courses as follows: Fall term: advanced dairying, 18 seniors; household dairying, 4 senior women. Winter term: advanced dairying, 15 seniors. Spring term: advanced dairying, 12 seniors. Dairy experimentation, 8 juniors. Elementary dairying, 2 classes, 23 sophomores, 22 freshmen. Valuable assistance was rendered in the laboratory, with sophomores and freshmen, by Instructors Anderson and McWethy.

The short courses were given due attention, during the winter term, under the direction of Prof. Smith, and the records of that work were submitted to him.

During the year the free testing of samples sent in from various parts of the state was continued, 138 samples of milk, and 46 samples of cream being tested for butterfat, and several samples of butter scored and tested for moisture.

During vacations, the milk from farms that supply the boarding clubs when college is in session, has been handled at the dairy.

The most important repairs and improvements made in the dairy during the year are as follows:

New floors, ceiling and wainscoting were put in the cheese room, wash room, creamery room and farm dairy room.

The large motor was replaced by three small ones.

A hood and sink were put in the testing room, and chemicals added for use in giving instruction in milk inspection.

New lockers and sinks were placed in the basement, for the use of both short course and regular students.

A new desk, and a case for books, blanks and laboratory supplies were placed in the office.

A considerable amount of new equipment was also added from short course funds.

A complete record of the equipment belonging to the farm department and to the special courses, also of the machinery that has been loaned to the college by various firms, will be found in the record books in the dairy office.

Mr. L. J. Smith reports the following from the division of farm mechanics:

This, the first year's work in farm mechanics, was begun with practically no old equipment. Two rooms in the old tool barn were used the year before for the purpose of giving instruction to the short course students in forge and wood shop.

The north lower room contained 25 hand blowers and forges with anvils and tools for the same. There was no floor in this room, the forges setting right on the sandy ground. Before instruction was given to the regular students, a concrete floor was put in the shop, a suitable blacksmith bench made, and a wash room fitted up. Mr. A. Anderson, of Hubbardston was secured to give instruction in forge work. He came to us with practical experience both on the farm and in blacksmith and general implement and wagon repair work, and has proved himself well adapted to the line of instruction which should be given to argicultural students. He also does the college horse shoeing and the farm department repair work.

The room directly above the forge shop was used as a wood shop. The tools were in good condition; but, the benches were rather crude, having been put together by the short course students during their first two weeks in that work and without previous training. These benches are being replaced by better constructed ones and of a type similar to that which would be adapted for farm use. The inferior benches, especially

the vises of the same, and the smoke and dust from the forge shop below, greatly hindered the students, but the work done was very creditable.

The work in farm power machinery was confined to instruction on, and the practical use of, the gasoline engine, steam engine, traction engine and hydraulic ram. Some work in concrete and cement was given. Owing to the great interest among farmers in the use of the gasoline engine, special attention was given to the subject, both in the lecture room and in the laboratory, which occupied the lower south room of the old tool barn. Here we had seven gasoline engines of various makes which were loaned by different firms. During the fall term, the farm department secured a combination eleven ton road roller and traction engine from the Port Huron Engine and Thresher Co., which has not only been useful in the class work, but has been a great convenience to the college in road work, silo filling, etc.

The above subjects were also given to the short course students during the winter term. The aim has continually been to present such work as will be of practical value on the farm.

Mr. J. G. Halpin reports the following from the poultry division:

During the past year there has been added to the stock mentioned in last year's report, a few each of the following breeds: Black Orpingtons, Pekin and Indian Runner ducks. About 1000 chicks were hatched and brooded during the months of April and May. All of the eggs used for incubation purposes were produced on the college farm, with the exception of those bought to secure the additional breeds mentioned above.

During the year sixty-six men and one woman registered for poultry work. Of this number twenty-six were second year winter course men who received one hour's lecture a day during the month of January. Six others began the work at the beginning of the fall term and carried ten hours a week during the fall and winter terms. During the winter six men elected poultry work and received three lectures a week, with no credits given in the college. At the beginning of the spring term it was decided to allow some of the seniors and juniors to elect ten hours a week in poultry. Twenty-eight men elected this course and were given as thorough a course as possible in so short a time. The work is made as practical as possible, including the operating of incubators, feeding laying hens, killing and dressing market poultry, and as many as possible of the practical things that one meets with on a poultry farm.

In addition to the instruction given at the college several days were spent attending farmers institutes, and ten days with the institute train.

REPORT OF THE DEPARTMENT OF HORTICULTURE AND LANDSCAPE GARDENING.

President J. L. Snyder:

Sir: I submit the report of the department of Horticulture and landscape gardening for the year ending June 30, 1907.

Course of study. The new course of study adopted by the faculty permits this department to inaugerate several desirable changes in its schedule among which are the following:

The futility of requiring women students to take the same work given to men students, especially the courses in vegetable gardening and fruit growing, has long been apparent to us. The men have had much preliminary work that the women have not; moreover few women students are interested in commercial fruit growing and vegetable gardening, but they are interested in such subjects as the planting and care of home grounds, flower growing, window gardening and the home vegetable and fruit garden. The new schedule provides for two special courses, elective to women students only, covering this work.

A second improvement is in the distribution of time. We have had 15 hours a week for junior fruit growing and 13 hours a week for sophomore vegetable gardening, and all students in the agricultural course have been required to take these long professional courses. This time is now cut in half, and the courses given are amateur, not professional, the professional work being given in the junior and senior years to those students who have elected horticulture. In other words, a distinction has been made between amateur and professional horticulture, and the amount of time given to the former has been reduced in order that there may be ample time for professional training in the senior year.

A third advantage is the opportunity that the student now has to specialize in his senior year on one branch of horticulture. Formerly all horticulture students took the same work throughout. But we must recognize that what is commonly called horticulture includes several very distinct lines of work. There is no more relation, for example, between the two horticultural subjects, greenhouse industry and pomology, than between vegetable gardening and agronomy. Moreover, this department teaches landscape gardening, which, as a profession, is not horticulture at all but an art, based partly on horticulture, partly on engineering and partly on architecture. So the demand has arisen for special training in each one of the several distinct branches of this department. Just as the agricultural department is now splitting up into agronomy, animal industry, dairying and poultry industry divisions, etc., so the horticultural department must eventually split up into the several distinct divisions of landscape gardening, pomology, greenhouse industry and vegetable gardening. This division will be much slower with us than that now in progress in the agricultural department because the commercial interest represented are not as large; but it will inevitably come in response to the increasing demand upon the college for more

technical and more highly specialized training. The first great division of our work that should be emphasized, and ultimately to the extent of giving it departmental standing, is landscape gardening. The new course provides for special training in this subject in the senior year, besides the general course given to all horticultural students in the junior year. The divisions of horticulture that we propose to emphasize most at present are pomology and landscape gardening.

Methods of Instruction.—The greatest difficulty that this department meets in presenting certain subjects to students is the fact that they leave college in June, when the orchard and garden operations have barely begun, and return in late September, when the season's work is practically over. Horticulture cannot be taught successfully out of books; learning by doing is the only practical method. This means that many of our students graduate with but little experience in doing summer work, which is, of course, the most important work. Several solutions of the difficulty are possible. The students may be required or advised to spend one or more of their summer vacations on "accredited farms" working for pay to learn the practical side of it. This method has been tried by several agricultural colleges and schools and has not usually been successful, chiefly because the student is apt to be considered merely as a laborer, and no effort made by the farm owner to explain and direct.

A second method, and the only really satisfactory one, is to require horticultural students to stay here for a summer session of six to eight weeks, during at least one of the summer vacations. In order that this may not work a hardship on those who are obliged to earn money in the summer to pay their college expenses, it would be imperative that the students be paid the regular student wage—15c an hour—for this time. They would be expected to do all the regular work connected with the department orchards and gardens, but a field class would be held daily to point out the important points. This is an extension of the present policy of hiring several horticultural students to work for the department during the summer, but with the difference that classes would be held and the boys would study as well as labor. We should expect the board to recompense the department for the wage of these students, in so far as it would exceed the sum that the department would have had to expend for labor if it had not student help.

The Changed Function of the Greenhouses.—Within ten years there has been a decided change in the function of the college greenhouses. Formerly they existed chiefly for two purposes—to grow flowers and plants to sell, or to give to the friends of the college; and to grow a large collection of exotics for the edification of visitors as well as for the enlightment of students. Primarily they were conservatories; their use for purposes of instruction were secondary.

The new and growing demand upon the greenhouses is that they be used for purposes of instruction and investigation. This demand is due partly to the growing interest in greenhouse industry and the increasing importance of glass-farming in this state. But it is due much more to the necessity for using the greenhouses as a laboratory for the horticultural course as a whole. I have pointed out that the students in horticulture are at a disadvantage in that they are not at the college during most of the growing season, and have suggested a partial solution.

Another partial solution is to require the students to grow crops and make experiments in the greenhouses, throughout the college year. I would have every horticultural student assigned a strip of greenhouse bench or bed on which he will be expected to grow certain crops and make certain experiments throughout the last two years of his course. We need, for example, a greenhouse which is merely a piece of land covered over with a glass roof, in which a vegetable garden can be made in winter, and an orchard laid out and planted. In other words, we now need greenhouses as laboratories for the horticultural course as a whole, not merely for the particular subject of floriculture; and this need far outweighs their usefulness as conservatories, which was their chief function in earlier years. Other agricultural colleges are experiencing the same difficulty and some of them are solving it in the manner that I shall now recommend.

This point of view concerning the usefulness of greenhouses to the college points to but one conclusion: that there should be a separation of greenhouses, some being used for conservatories and crop culture purposes, and some for student laboratories. It would be desirable if expedient, to retain the present greenhouses for the former purpose and to build new ones near the horticultural laboratory for student use and for experiments. At the present time no addition to the equipment of the department would increase its efficiency more than the erection of student greenhouse laboratories.

Changes, Additions and Improvements.—The remainder of the south block of apples has been thinned, so that the trees stand two rods apart and about fifty trees in this block have been top-worked. The middle block of apples will be thinned. A small commercial plum and cherry orchard, two varieties of each, has been planted, also a small commercial field of raspberries and blackberries. A commercial vineyard, and a commercial pear orchard will be planted next spring. The general plan is to have a small commercial planting of each fruit, including only two or three standard varieties. At present we have but one to three trees or plants each of a great many varieties, most of which are, of course, unsuitable here. We shall restrict but not eliminate the testing of varieties; and add small commercial plantings of each fruit. The same plan is followed with vegetables.

By special appropriation of the board the main campus drive was macadamized last fall, from the chemical laboratory to Howard Terrace. The board should adopt the general policy of putting in a small piece of macadam road each year, until all the main drives are improved. Following the suggestions of Mr. O. C. Simonds, the landscape gardener employed by the board, several drives have been sodded down, and the main drive brought in front of the Women's building, thus leaving no roads across the centre of the campus. The board has approved this plan and expressed the wish that no building be placed inside the main drive, except, possibly, where College Hall now stands; and that this area remain for all time as the campus, unviolated by buildings.

During the year we have lost Mr. C. A. McCue, instructor in horticulture, who was called to be professor of horticulture and horticulturist of the experiment station in the Delaware College, a position which his excellent work here has qualified him to fill. Instructor A. R. Kohler goes to the Minnesota Agricultural College with a record for efficient

service here. The new instructors are Mr. C. P. Halligan, a graduate of the Massachusetts Agricultural College, and formerly an instructor there; and Mr. O. I. Gregg, a graduate of this college in the class of 1907. Mr. Halligan has had special training and experience in landscape gardening and will give particular attention to that work here. Mr. Gregg will have immediate charge of the experimental work of the department, with a small amount of class-room work in pomology and gardening.

Respectfully submitted,

S. W. FLETCHER,

Professor of Horticulture and Landscape Gardening.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF BOTANY.

President J. L. Snyder:

The following is my report for the year ending June 30, 1907:

A summary of the classes and number of students enrolled and instructed is as follows:

Class.	Subject.	Term.	Hours per week.	Students enrolled.
Graduates		Fall, winter, spring	5	2
Srs. and Jrs. in Agric. and forestry	Plant physiology	Spring	9	13
Seniors and women	Plant physiology	Fall	7	10
Seniors and women	Histology	Spring	9	4
Juniors, agricultural	Plant pathology	Fall	9	61
Juniors, agricultural	Grasses and other forage plants	Winter	4, ½ term	25
Juniors, agricultural	Weeds	Winter	4, ½ term	27
Juniors, agricultural	Trees and shrubs	Spring	5, ½ term	26
Juniors, forestry	Wood technology	Winter	8	4
Sophomores, agricultural	Plant histology	Winter	7	42
Sophomores, agricultural	Ecology	Spring	3	45
Sophomores, women	Trees and shrubs	Spring	5, ½ term	31
Sophomores, women	Plant histology	Winter	6	10
Freshmen, agricultural	Taxonomy	Spring	3	40
Freshmen, women	Taxonomy	Spring	3	28
Freshmen, agricultural	Fruits and Seeds	Fall	4½	69
Freshmen, women	Fruits and Seeds	Fall	4½	39
Sub-freshmen, agricultural	Beginning	Fall	2	15
Sub-freshmen, agricultural	Beginning	Spring	2	39
Sub-freshmen, women	Beginning	Spring	4	15
Short courses	Beginning	Winter	5, 8 wks.	3
Total				556

BOTANIC GARDEN.

As mentioned in previous reports, in three successive years, 1904, 1905, 1906, there were three unusual freshets which overflowed very nearly all the garden, covering it with water each time for a period of five to six days or more. The freshet in the early spring of 1904 did comparatively little injury to the plants, since they were in a dormant

condition. Considerable dirt was washed out including a few plants. The freshets in June, 1905, 1906, killed many plants, injured many more and rendered the garden unsightly for six weeks to two months of the growing season.

Records were made showing which plants were uninjured by the high water and by shifting the places of growth, it was found unnecessary to raise all the land composing the two acres of the garden. Rather more than one-half of the area has been raised or should be raised from one foot to four feet or even more to avoid the risk of damage by high water. During the last half of the year 1906 with a little work in early spring of 1907, a large area of the valley on the north and west side of the brook was raised to highwater mark. This is tedious work as the plants where the ground is to be raised, all have to be removed during the operation; the surface soil removed into piles, poor or cheap soil and rubbish used for filling the bottom, the top dirt replaced, graded and paths made anew, and plants reset in their old places. The operation of two removals of plants during so short a period kills some of them and reduces the size of all others, besides rendering a large block of the garden unsightly for a year or more.

This summer I have planned to raise the east end of the garden and make some other improvements. At the time of writing this report, by actual count there are 2027 species and varieties of seed-plants, ferns and their allies, under cultivation in this garden. A quarter or more of these repeatedly fail to develop well or soon die outright, because I do not give them the proper care or they are not suited to our soil or climate. If, in place of these, larger patches of more thrifty plants were grown the garden would present a much finer appearance, especially to those having little knowledge of plants, but the botanist is ever loath to abandon his efforts to grow the choicer or rarer plants of the woods, swamps and ravines. The grasses and weeds are nearly all grown in the families to which they belong.

Although known as a botanic garden, it is in an unusual degree an economic garden, especially so in regard to plants for the farm, the garden and those grown for ornamenting a home, the roadside or a park. Recent reports make it unnecessary for me to write more at this time concerning the garden.

THE HERBARIUM

The additions that have been made during the past year are here enumerated:

Seed Plants, Ferns and their allies.

C. F. Baker, plants from the Pacific Coast	55
S. H. Pepoon, plants from southwest Michigan	128
L. M. Umbach, Desiderata	80
Francis Daniels, plants from Colorado	868
C. G. Pringle, Mexican plants	300
Home collections	75

FUNGI.

E. Bartholomew, Fungi Columbiana, Centuries XII and XIV...... 200

ALGAE.

F. S. Collins, Fascicles XXVII, XXVIII........................ 100

Total additions for the year 1806

GENERAL SUMMARY OF PLANTS IN THE HERBARIUM.

Seed Plants, ferns and their allies	18,147
Mosses and Liverworts	2,010
Lichens	1,186
Fungi	17,153
Algae	2,220
Grand total in Herbarium	103,716

THE ARBORETUM.

The plants continue to grow and afford many convient and important illustrations for classes in forestry and botany, but there appears to be no chance for further enlargement. It cannot be kept very tidy owing to the great number of persons who make a wide path extending diagonally across, scattering rubbish of various kinds and disfiguring and destroying the trees. The deer and elk have well nigh destroyed the trees that were permitted in their yards. Owing to its location, the time must doubtless come before many years, when this area will be sought for building or other purposes. Anticipating this change, Professor Bogue has already begun a mixed plantation across the river east of the spur of the Peŕe Marquette railway.

QUESTIONS ANSWERED.

Beginning in January of this year and continuing to the close of June, at my request the stenographer has kept a list of questions answered by the professor of botany. They number two hundred and thirteen and I know others have been written by myself of which she had no account. Many of these questions were answered with little effort, but some of them required each an investigation of an hour or two, and not infrequently one to three pages were written by a typewriter. Eighty-four replies were made to inquiries concerning seeds or plants of weeds, forage plants and the like. Among the other inquiries were the following:

By sample of muck to determine whether it would pay to drain land; to review a book on Principles of Botany; to report on trouble with six lots of diseased beans; regarding conditions for growing the common locust; on growing basket willow; information regarding the ornamentation of school grounds; asking for elementary science bulletin; names of grasses for a mixture for pasture; many inquiries concerning the extermination of quack grass; how does the atmosphere supply plants with nitrogen; request information concerning soil inoculation for legumes; how to obtain seedless fruits; how to recognize edible mushrooms from those poisonous; how to grow golden seal; how to grow

ginseng; the best way to test vitality of seeds; how to distil wintergreens; making a lawn on a lake shore; what is sweet fern good for; planting forests to prevent floods; sending forty kinds of plants to grow on grounds of state fair; to what extent are bumble bees necessary to pollinize red clover; what ails my maple trees; where is there a market for seed of Jimson weed; source and habits of the common house fly.

DONATIONS TO THE BOTANICAL DEPARTMENT.

From C. F. Baker, '91, Cuba, 229 herbarium plants from west United States.

From Prof. S. B. Green, St. Anthony Park, Minnesota, Solanum commersoni.

From Miss Annette Richards, Grand Rapids, Plants of Mertensia Virginica.

From Prof. C. S. Sargent, Director of the Arnold Arboretum, Mass., 88 trees and shrubs.

Respectfully submitted,
W. J. BEAL,
Professor of Botany.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF BACTERIOLOGY AND HYGIENE.

To President J. L. Snyder:

As long as one year repeats another in the number of students instructed, and in the courses offered, little is to be advantageously added to former reports. Our gains are in technical pedagogy and subject matter. In the manipulation of material and in arrangement of our work, each year contributes much and seems to place us ahead of previous years many notches. In other words we feel, as a department, that we are making progress.

To discuss, in this connection, such factors as are instrumental in this progress, would doubtless be unwelcome and savor of the pedant. Therefore I stop before I enter upon a theme.

It would be unfair, however, to omit acknowledgement of the help of Mr. W. G. Sackett, who with Dr. Wetmore, has had charge of the laboratory class work in bacteriology. Both also have been diligent and efficient in the class room. Mr. L. D. Bushnell did excellent work with short-course students.

The hospital, under the direct management of Miss Ketcham, has done its share of good the past year. The greatest difficulty we have in caring for the sick may be noticed during epidemics when we have to resort to the inconvenient "Board Rooms," inconvient because of no facilities to feed the patient and because of improper care.

Very respectfully,
CHARLES E. MARSHALL,
Professor of Bacteriology and Hygiene.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF FORESTRY.

To the President:

Sir: The forestry department has continued the usual rate of increased interest during the year. Mr. F. H. Sanford, who assisted in the department from December 1, 1906 to July 1, 1907, rendered valuable service. By a rearrangement of the agricultural and forestry courses, the forestry students will, until further change, continue forestry from the beginning of the spring term of the sophomore year. This is a decided advantage as by this arrangement some of the technical agriculture formerly required is replaced with a forestry subject.

The records show that the total enrollment of classes was 155 the number of different students being 64. The farm wood-lots have been further improved by the removal of inferior trees and their replacement with more valuable species. In this work about 200 cords of wood were cut which netted 80 cents per cord for soft wood and $1.40 per cord for hard wood. The forest nursery has been extended to include five acres. The whole area has been much improved by a rearrangement and the laying out of cross drives. A permanent plantation of the more valuable species of forest trees has been made with the expectation that it will take the place of the 30 year plantation near the postoffice and serve to demonstrate the comparative value of the different species for forestry purposes. About 20,000 trees were planted in the wood-lots on the college farm, consisting mostly of locust, chestnut and white ash. Surplus trees to the value of $117.65, not suitable for planting or not needed here were sold. According to the direction of the State Board of Agriculture, trees were distributed gratis to 16 state institutions for the ornamentation of their grounds. All reports received from these consignments state that the trees were received in excellent condition and were much appreciated.

The department continues in the present cramped quarters. More space for classes, laboratories and museum should be provided as soon as possible. We need the floor space stated in my communication to you under date of December 26, 1906, viz, 9692 square feet. This space should be provided either in the agricultural building to be erected or in the present dairy or agricultural building. The museum specimens belonging to this department are at present stored in five different buildings some having been destroyed for want of a proper place for their preservation.

Respectfully submitted,

E. E. BOGUE,

Professor of Forestry.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF MECHANICAL ENGINEERING.

To the President:

Since the resignation of Professor Weil, Sept. 14, 1906, the writer has been in charge of the mechanical engineering department. On taking charge, I found the department was lacking two instructors to fill out its usual quota. Strenuous efforts were made to obtain one of these and it has been entirely impossible to fill the other position up to the present time. Mr. Henry F. Schmidt had been engaged and arrived on the 17th of September and Mr. J. A. Polson arrived on the 18th and began work immediately. By strenuous efforts on the part of all of the force, we managed to present every course that had been previously given and in a very satisfactory way considering the crowded condition of the building and the cramped space for recitation rooms. Mr. A. W. Wilson, a senior in the engineering course, was called upon to assist with one class. The spirit of the members of the force who were here was excellent and everyone, including the new members of the force, co-operated to produce the best possible results.

Mr. W. S. Leonard had resigned during the summer on account of ill health and I found the department had suffered a severe loss and up to the present time we have been unable to find someone to take his place. The teaching force for the fall term consisted of the following instructors:

Mr. Henry F. Schmidt, instructor in thermodynamics and machine design.

Mr. J. A. Polson, instructor in kinematics, metallurgy and senior laboratory work.

Mr. L. L. Chappell, instructor in machine shop.

Mr. E. C. Baker, instructor in foundry practice.

Mr. W. R. Holmes, instructor in forging.

Mr. A. P. Krentel, instructor in wood shop.

Mr. E. C. Crawford, assistant in laboratory work.

On January 6th, Mr. Schmidt resigned and Mr. L. L. Appleyard was engaged until the first of April to take his place. Mr. E. N. Bates was employed as instructor in steam engine design for the spring term and in this way every course usually offered was given.

During the fall and winter terms, considerable apparatus was purchased for use in the laboratory work of the seniors. Electric motors were installed to replace the steam engine for driving the machinery in all the shops.

The senior class this year was graduated during the week of the semi-centennial which occurred the last week in May. Therefore, it was necessary that the thesis work should be completed considerably earlier than usual and Mr. Appleyard was elected to the position of assistant professor in mechanical engineering immediately after the termination of his temporary engagement.

During the month of June, the work of enlarging and rearranging the shops was begun and it is confidently expected that at the beginning of

the fall term, 1907, the enlarged facilities provided by the new engineering building will enable the mechanical department to carry on the work in a very much more satisfactory way than it has been possible for the past few years.

In addition to the work of directing the department of mechanical engineering, the writer was called upon to supervise the installing of the heating apparatus for the new engineering building and also the installing of the automatic telephone system all of which tended to make the year a very busy one for this department.

The number of students in the department this year has been practically the same as for the last three years owing to the fact that we have been unable to accommodate more than this number of students. The number of engineering students in the year of 1903-4 was 363, the number in the year 1904-5, 395, 1905-6, 393 and in 1906-7, 384.

Respectfully submitted,

A. R. SAWYER,

Acting Professor of Mechanical Engineering.

Agricultural College, Mich, June 30, 1907.

REPORT OF DEPARTMENT OF ENGLISH AND MODERN LANGUAGES.

President J. L. Snyder:

My Dear Sir:—In my first report relative to the department of English and Modern Languages, I wish to congratulate the college on the efficiency of the department when it came under my care. Its organization was so satisfactory both as to courses and as to plans that I have found occasion to make practically no changes of any kind during the year, and for the coming year to arrange for only those made necessary by the new courses in Agriculture and Domestic Science.

I found a helpful and hard working corps of assistants. Each of them throughout the year has made the welfare of the department his first thought, with the result that I have only praise for their work.

One who was especially useful to me in becoming acquainted with the affairs of the department, Miss Bertha M. Wellman, has resigned, her resignation taking effect with the close of the year. Her familiarity with every detail was invaluable to me, as her efficient teaching during her years in the department must have been to unnumbered students. Every member of the department regrets her resignation, and wishes her only sunshine in the duties which she assumes.

The new courses of study reduce more than one-half the required work in this department. This means that the required work must be maintained at the highest degree of efficiency on the practical side, and that the electives must be given a clearly evident bread earning as well as cultural value if students are to get the training necessary to a well-rounded education.

In one of his later reports my predecessor expressed his regrets that large classes made impossible the written work necessary to satisfactory results. Not only the papers of students, but also letters from

students and graduates, prove that in general their written expression is not satisfactory. Accuracy and effectiveness of expression come only by means of much practice under guidance. Such practice is not possible unless the teacher (or a reader) is able to mark many papers which later are to be corrected by the student. Director Smith states frequently that many of our graduates are handicapped and retarded in their work by lack of familiarity with business methods and *by poor English.*

My recommendation is that the department be provided with readers sufficient to make possible continued practice in the writing and correction of business English, as well as of the more conventional theme work, throughout all English classes. To increase the number of teachers so as to make this possible would give better results, but would probably be considerably more expensive. If the teachers are possible, I should urge this solution rather than the other. If one of these assistants were able to act as office assistant also, helping in correspondents, records, duplicating work, etc., it would add much to my time for more important duties.

In the modern languages I feel that special emphasis should be placed on the practical side, on the conversational and business uses of the language. To this end I recommend the purchase of two language phones, one for men and one for women. These mechanical aids to learning language are in use in many colleges and universities. They have been examined by our teachers, who believe that the work would be not a little advanced by use of them.

I also recommend that Spanish be added to the languages taught by the department, especially to engineering students. Work in this language could be introduced by offering it to students who come with considerable high school German and who in the past have been given college credits for high school work—a practice of which I by no means approve. Spanish is almost essential to an engineer of wide practice, as the Latin countries to the south are continually calling for electrical and mechanical specialists trained in the States.

In this institution of laboratory work, I feel that the teaching of literature should be much more largely along laboratory lines than is possible with our cramped library facilities. Later, when this deficiency is remedied, I shall have a definite recommendation for the establishment of what may be called an English laboratory.

I wish to express to you, to the members of the State Board, and to my faculty colleagues, my sincere appreciation of the cordial friendliness with which my family and myself have been received, coming as strangers to make a home at the college.

Most respectfully,

THOS. C. BLAISDELL,

Professor of Eng. and Mod. Languages.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF CHEMISTRY.

Mr. J. L. Snyder, President, M. A. C.:

Dear Sir:—I herewith present the report for the year 1906-7 from the Chemical department.

Our principal work has been with the students and the following schedule gives something of an idea regarding the number of students and the amount of instruction given them:

Fall term.	Number of students.	Instruction hours per week per student.
General Chemistry:		
Agricultural and mechanical	190	7
Women	54	7
Organic Chemistry:		
Agricultural	48	7
Women	35	7
Total hours instruction (per term)	....	2,289

Winter term.	Number of students.	Instruction hours per week per student.
Mineralogy, mechanical	99	5
Qual. Anal., women	42	10
Qual. Anal., men	70	10
Agricultural chemistry, men	40	7
Total hours instruction (per term)	....	1,895

Spring term.	Number of students.	Instruction hours per week per student.
Mechanicals, third term	84	6
Quantitative analysis	14	10
Domestic science chemistry	10	10
Animal nutrition	15	10
Total hours instruction (per term)	....	894

It was thought best to change the time for the domestic science chemistery from the winter term to the spring term as that allowed the domestic art department to give their instruction in millinery at at time best suited to the needs of the students. It was also advan-

tageous to this department as it enables us to distribute the work of the year more evenly and not have an excess of work in the winter term.

The class in animal nutrition did some interesting work in testing two animals from the grade dairy herd and were enabled to show by chemical analysis the great difference that exists between the efficiency as a milk producing machine of two different "scrub cows." Both cows were placed on the same feed and the result of the test plainly showed the students the effect of inherited tendencies so far as milk production is concerned. The experiment involved the care and feeding of the cows for a period of five days during which time they were under constant observation by the members of the class assisted by one man who was employed from the outside during the day. The result of this experiment appeared in print in the Michigan Farmer and I call attention to it because it illustrates a field of experiment in which our students cannot get too much training and in which they are deeply interested.

We have during the year purchased considerable new and valuable apparatus, among which I may mention the new Junker's Gas Calorimeter, modified to allow the testing of both gaseous and liquid fuels. It is of special interest to engineering students although the proposed production of alcohol by the American farmer renders the instrument also of considerable interest to the agricultural course student.

Aside from the direct work of giving instruction in the laboratory Mr. Reed and myself devoted considerable time to the work which was necessarily placed upon us in preparing for the semi-centennial. I was a member of the "general committee" and also a member of the committee to provide rooming accommodations for the guests. Mr. Reed was a member of the committee on "badges and registration."

During the year the catalogue of the alumni to date has been completed and in now practically ready for publication.

During the winter term I appeared on the program at the county institutes held at Charlotte, Marshal, Brooklyn, Coldwater and Constantine, speaking on the topics of "Plant Food" and the "Farmer's Water Supply."

As the course of study had not been changed for four years the faculty considered that 1907 (semi-centennial year) was the proper year for the changing of the curriculum of study. In doing this they have though it best to take out agricultural chemistry which is the last "required" chemical subject in the present college course and in the new course make it optional. Whether this is the proper place to go on record or not I do not feel sure but I, however, wish to make it plain that in my opinion the placing of agricultural chemistry as an "optional" study in the curriculum of an Agricultural course in this the oldest agricultural college is a thing not to be thought of. I therefore place myself on record as being very much opposed to such a change.

The organization of this department during the past year has been as follows:

Instructors: H. S. Reed, H. S. Bailey, A. J. Clark, F. J. Kaufman, E. A. Goodhue, clerk and stenographer, George Churchill, care taker.

I wish to acknowledge the hearty co-operation and great assistance which I have received from every member of the laboratory force.

Respectfully submitted,

FRANK S. KEDZIE,

Professor of Chemistry.

Agricultural College, June 30, 1907.

REPORT OF THE DEPARTMENT OF PHYSICS AND ELECTRICAL ENGINEERING.

To the President:

During the school year of 1906-7 just closed, the work in physics and electrical engineering was carried on by the following instructors and myself: Mr. H. L. Curtis, Mr. E. N. Bates, Mr. W. L. Lodge after the first of October and Mr. C. W. Chapman after the first of January.

Owing to my extra duties in charge of the mechanical department, the men in the department were pretty busy and Mr. Chapman was engaged to begin the first of January. The work was carried on as well as could be expected under the exceedingly cramped conditions. During the fall term, as has been the custom for the last three years, a number of seniors in the engineering course elected to take some electrical work in place of machine shop which class I carried in addition to the other duties. The same condition will probably exist another year owing to the fact that the new course in electrical engineering will not reach the senior year until the fall term of 1908.

A small amount of apparatus was added to the equipment—quite a little being ordered from abroad—but, owing to the inability of the makers to properly standardize the apparatus, it has not been delivered up to the time of the writing of this report although we are expecting it every day and it will be ready for use next year.

During the spring term especially, the department has been particularly crowded and every member of the department is eagerly looking forward to the time when we will be able to expand somewhat and have more conveniences under the new conditions.

Respectfully submitted,

A. R. SAWYER,

Professor of Physics and Elec. Eng.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF MATHEMATICS AND CIVIL ENGINEERING.

President J. L. Snyder:

Dear Sir:—To write a review of the past year's work in this department would be to repeat much of what was recorded in my last report. Lack of suitable class rooms, storage space, laboratories and offices have hindered more than ever before the satisfactory arrangement and prosecution of our alloted share of college work. Without an able corps of instructors working in perfect harmony we could not have attained even a tolerable measure of efficiency.

It is a pleasure to note that a very recent apportionment of space in the new engineering building assigns to this department several times as much space as was conceded at the time of my last report.

The department staff has included for the year the following teachers: associate professor, W. Babcock and instructors A. E. Jones, C. Gundersen, A. R. Alger, S. C. Hadden, G. James, J. H. Taylor and W. B. Wendt. My thanks are due these gentlemen for unvarying zeal in promoting the welfare of the department and college, for efficient services in the direction of class work and for helpful advice and suggestion.

The following is our usual tabulation showing particulars concerning the classes met during the year:

Class work of the department of mathematics and civil engineering for the college year 1906-'07.

Class.	Subject.	Number of course.	Teacher.	Class room.	Hour of meeting.	Hours per week.	No. of students in class.
Fall term.							
Sub-freshmen	W. algebra	Math. 1	Mr. James	Dairy	11–12	5	14
Sub-freshmen	Ag. algebra	Math. 1	Mr. Wendt	Dairy	8–9	5	29
Sub-freshmen	Ag. algebra	Math. 1	Mr. Wendt	Dairy	9–10	5	25
Sub-freshmen	Eng. algebra	Math. 1c	Mr. Taylor	8, College Hall	8–9	5	19
Sub-freshmen	Eng. algebra	Math. 1c	Mr. Taylor	8, College Hall	9–10	5	17
Sub-freshmen	Eng. algebra	Math. 1c	Mr. Hadden	Horticultural	9–10	5	16
Sub-freshmen	Eng. algebra	Math. 1c	Mr. Jones	8, College Hall	2–3	5	16
Freshmen	Ag. & W. algebra	Math. 1b	Mr. James	6, College Hall	3–4	5	28
Freshmen	Ag. & W. algebra	Math. 1b	Mr. Jones	8, College Hall	3–4	5	29
Freshmen	Ag. algebra	Math. 1b	Mr. Taylor	8, College Hall	10–11	5	12
Freshmen	Ag. algebra	Math. 1b	Mr. Wendt	Dairy	10–11	5	10
Freshmen	W. algebra	Math. 1b	Mr. Jones	8, college Hall	1–2	5	26
Freshmen	Eng. geom	Math. 2d	Mr. Alger	12, College Hall	8–9	5	19
Freshmen	Eng. geom	Math. 2d	Dr. Gundersen	Abbot Hall	11–12	5	18
Freshmen	Eng. geom	Math. 2d	Prof. Babcock	6, College Hall	1–2	5	10
Freshmen	Eng. geom	Math. 2d	Mr. Jones	6, College Hall	1–2	5	37
Freshmen	Eng. algebra	Math. 1e	Mr. James	Dairy	11–12	5	35
Freshmen	Eng. Algebra	Math. 1e	Prof. Babcock	12, College Hall	10–11	5	24
Freshmen	Eng. algebra	Math. 1e	Mr. James	Abbot Hall	1–2	5	18
Freshmen	Eng. algebra	Math. 1e	Dr. Gundersen	6, College Hall	2–3	5	37
Freshmen	Eng. algebra	Math. 1e	Dr. Gundersen	Abbot Hall	10–11	5	23
Sophomores	Eng. anal. geom	Math. 5	Mr. James	Abbot Hall	8–9	5	15
Sophomores	Eng. anal. geom	Math. 5	Prof. Babcock	6, College Hall	8–9	5	15
Sophomores	Eng. anal. geom	Math. 5	Dr. Gundersen	Abbot Hall	9–10	5	18
Sophomores	Eng. anal. geom	Math. 5	Mr. Jones	Agricultural	9–10	5	14
Sophomores	Eng. & W. anal. geom	Math. 5	Prof. Babcock	6, College Hall	9–10	5	15
Juniors	Eng. surveying	C. E. 1b	Prof. Vedder	2, College Hall	10–11	2	25
Juniors	Eng. surveying	C. E. 1b	Mr. Alger	6, College Hall	10–11	2	21
Juniors	Eng. surv. (field)	C. E. 1b	Mr. Alger, Mr. Taylor and Mr. Wendt		1–3	2	19
Juniors	Eng. surv. (field)	C. E 1b	Mr. Alger, Mr. Taylor and Mr. Wendt		1–3	2	26
Juniors	Mech. of Eng	Math. 7a	Mr. Hadden	2, College Hall	11–12	5	17
Juniors	Mech. of Eng	Math. 7a	Mr. Alger	8, College Hall	11–12	5	14
Juniors	Mech. of Eng	Math. 7a	Prof. Babcock	12, College Hall	11–12	5	15
Senior	Ag. civ. eng. (class)	C. E. 2	Mr. Alger	12, College Hall	9–10	4	16
Senior	Ag. civ. eng. (field)	C. E. 2	Mr. Alger		1–3	2	16
Seniors	Graphics	C. E. 4	Mr. Hadden	2, College Hall	8–9	3	25
Seniors	Graphics	C. E. 4	Prof. Vedder	2, College Hall	9–10	3	19
Seniors	Railroad surveying	C. E. 7	Prof. Vedder, Mr. Hadden and Mr. Wendt	2, College Hall	1–4	6	33
Seniors	Bridge stresses	C. E. 8a	Prof. Vedder	2, College Hall	10–11	3	27
Totals	39 Sections					179	837

Class work of the department of mathematics and civil engineering.—Continued.

Class.	Subject.	Number of course.	Teacher.	Class room.	Hour of meeting.	Hours per week.	No. of students in class.
Winter term.							
Sub-freshmen....	Ag. algebra..........	Math. 1a...	Mr. Wendt..............	Dairy..........	9–10	5	19
Sub-freshmen....	Ag. algebra..........	Math. 1a...	Mr. Wendt..............	Dairy..........	10–11	5	24
Sub-freshmen..	W. Algebra..........	Math. 1a...	Mr. Taylor..............	8, College Hall..	10–11	5	13
Sub-freshmen.....	Eng. algebra........	Math. 1d...	Mr. James..............	Abbot Hall.....	10–11	5	15
Sub-freshmen....	Eng. algebra..........	Math. 1d...	Mr. Alger..............	12, Botany.....	10–11	5	16
Sub-freshmen....	Eng. algebra..........	Math. 1d...	Mr. Jones..............	Abbot Hall.....	2–3	5	19
Sub-freshmen....	Eng. algebra..........	Math. 1d...	Mr. Alger..............	7, College Hall..	2–3	5	18
Freshmen.......	Ag. geom.............	Math. 2b...	Mr. Taylor..............	8, College Hall..	9–10	5	24
Freshmen.......	W. geom.............	Math. 2b...	Mr. James..............	8, College Hall..	1–2	5	15
Freshmen.......	Eng. algebra..........	Math. 1f....	Dr. Gundersen..........	12, College Hall.	1–2	5	20
Freshmen.......	Eng. algebra..........	Math. 1f....	Mr. Jones..............	Abbot Hall.....	1–2	5	24
Freshmen.......	Ag. geom.............	Math. 2b...	Mr. Taylor..............	8, College Hall..	8–9	5	19
Freshmen.......	Ag. geom.............	Math. 2b...	Dr. Gundersen..........	12, College Hall.	9–10	5	21
Freshmen.......	W. geom.............	Math. 2b...	Mr. James..............	8, College Hall..	2–3	5	20
Freshmen.......	Eng. algebra..........	Math. 1f....	Dr. Gundersen..........	12, College Hall.	11–12	5	19
Freshmen.......	Eng. algebra..........	Math. 1f....	Mr. Jones..............	Dairy..........	11–12	5	21
Freshmen.......	Eng. algebra..........	Math. 1f....	Mr. James..............	Abbot Hall.....	11–12	5	20
Sophomores.....	Calculus (dif.)........	Math. 6a...	Prof. Babcock...........	6, College Hall..	10–11	5	16
Sophomores.....	Calculus	Math. 6a...	Mr. Jones..............	7, College Hall..	10–11	5	15
Sophomores.....	Calculus	Math. 6a...	Prof. Babcock...........	6, College Hall..	2–3	5	18
Sophomores.....	Calculus	Math. 6a...	Dr. Gundersen..........	12, College Hall.	2–3	5	18
Juniors..........	Mechanics.............	Math. 7b...	Mr. Hadden.............	6, College Hall..	9–10	5	18
Juniors..........	Mechanics.............	Math. 7b ..	Mr. Alger..............	Abbot Hall.....	9–10	5	19
Juniors..........	Mechanics.............	Math. 7b...	Prof. Vedder...........	6, College Hall..	1–2	5	10
Seniors..........	Bridge design.........	C. E. 8 b...	Prof. Vedder...........	2, College Hall..	8–10	....	26
Seniors..........	Hydraulics............	C. C. 5.....	Mr. Hadden.............	2, College Hall..	11–12	5	13
Seniors..........	Hydraulics (lab.)......	C. E. 5.....	Mr. Hadden.............	....	1–3	4	13
Seniors..........	Hydraulics (class).....	C. E. 5.....	Mr. Wendt..............	6, College Hall..	11–12	5	17
Seniors..........	Hydraulics (lab.)......	C. E. 5.....	Mr. Wendt..............	....	1–3	4	17
Seniors..........	Astronomy............	C. E. 14....	Dr. Gundersen..........	12, College Hall.	10–11	2	29
Seniors..........	Water supply..........	C. E. 15....	Mr. Hadden.............	12, College Hall.	10–11	3	29
Seniors..........	Exper. Lab............	C. E. 12....	Mr. Alger, Mr. Taylor and Mr. Wendt	2, College Hall..	1–5	8	27
Seniors..........	Ag. & For. Agr'l Eng..	C. E. 3.....	Prof. Vedder...........	2, College Hall..	10–11	5	11
Totals......	33 sections............	....	....	....	....	156	623

Class work of the department of mathematics and civil engineering.—Concluded.

Class.	Subject.	Number of course.	Teacher.	Class room.	Hour of meeting.	Hours per week.	No. of students in class.
Spring.							
Subfreshmen	Ag. geometry	Math. 2a	Mr. Wendt	8, College Hall	8-9	5	26
Sub-freshmen	Ag. geometry	Math. 2a	Mr. Jones	Abbot Hall	9-10	5	15
Sub-freshmen	W. geom	Math. 2a	Mr. Wendt	8, College Hall	9-10	5	15
Sub-freshmen	Eng. geom	Math. 2c	Dr. Gundersen	12, College Hall	2-3	5	19
Sub-freshmen	Eng. geom	Math. 2c	Mr. James	12, College Hall	11-12	5	14
Sub-freshmen	Eng. geom	Math. 2c	Mr. Alger	Abbot Hall	11-12	5	20
Sub-freshmen	Eng. geom	Math. 2c	Mr. Taylor	Abbot Hall	10-11	5	20
Sub-freshmen	Eng. mensuration	Math. 3	Mr. Taylor	8 College Hall	10-11	5	15
Sub-freshmen	Eng. mensuration	Math. 3	Mr. Wendt	8, College Hall	10-11	5	15
Sub-freshmen	Eng. mensuration	Math. 3	Mr. Jones	8, College Hall	1-2	5	14
Sub-freshmen	Eng. mensuration	Math. 3	Mr. James	12, College Hall	1-2	5	16
Freshmen	Ag. trig	Math. 4a	Mr. Alger	2, College Hall	8-9	3	24
Freshmen	Ag. & W. trig	Math. 4a	Mr. Taylor	12, College Hall	8-9	3	21
Freshmen	Ag. trig	Math. 4a	Mr. Alger	12, College Hall	10-11	3	20
Freshmen	Eng. trig	Math. 4b	Mr. Hadden	Abbot Hall	8-9	5	17
Freshmen	Eng. trig	Math. 4b	Dr. Gundersen	[illegible]	8-9	5	17
Freshmen	Eng. trig	Math. 4b	Mr. Jones	Dairy	11-12	5	11
Freshmen	Eng. trig	Math. 4b	Mr. James	8, College Hall	11-12	5	14
Freshmen	Eng. trig	Math. 4b	Dr. Gundersen	6, College Hall	1-2	5	17
Freshmen	Eng. trig	Math. 4b	Mr. Jones	8, College Hall	1-2	5	17
Freshmen	Ag. surveying	C. E. 1a	Mr. Alger	8, College Hall	2-3	...	16
Freshmen	Ag. surv. (field)	C. E. 1a	Mr. Alger, Mr. Taylor and Mr. Wendt.	12, College Hall	10-11	2	22
					1-3	3	42
Freshmen	Ag. surv. (class)	C. E. 1a	Mr. Alger	2, College Hall	8-9	2	20
Sophomores	Int. Calculus	Math. 6b	Prof. Babcock	6, College Hall	8-9	5	14
Sophomores	Int. Calculus	Math. 6b	Prof. Babcock	6, College Hall	9-10	5	29
Sophomores	Int. Calculus	Math. 6b	Mr. James	Dairy	10-11	5	15
Sophomores	Int. Calculus	Math. 6b	Dr. Gundersen	6, College Hall	11-12	5	17
Juniors	High surv. (class)	C. E. 6	Prof. Vedder	2, College Hall	9-10	3	31
Juniors	High. surv. (field)	C. E. 6	Prof. Vedder, Mr. Hadden and Mr. Wendt		1-4	2	31
Juniors	Diff. equations	Math. 8	Prof. Babcock	6, College Hall	10-11	5	24
Juniors	Diff. equations	Math. 8	Dr. Gundersen	Dairy	10-11	5	21
Seniors	Masonry and arches	C. E. 9	Mr. Hadden	2, College Hall	10-12	4	27
Seniors	Pavements	C. E. 10	Prof. Vedder	2, College Hall	9-10	2	27
Seniors	Thesis	C. E. 11	Prof. Vedder and Mr. Hadden	Office	1-5	5	28
Seniors	Contracts & specifications	C. E. 13	Prof. Vedder	2, College Hall	10-12	2	36
Totals	35 sections					161	723

The Following text books have been used in our classes during the year: Beeman & Smith's Higher Arithmetic for classes in mensuration; Beeman & Smith's Academic Algebra for all beginning classes formed by women and agricultural students; Van Velzer & Slichter's University Algebra for all engineering students; Wentworth's Geometry; Ashton & Marsh's Trigonometry; Tanner & Allen's Analytic Geometry; Murray's Calculus; Differential Equations; Hodgman's Surveying; Johnson's Surveying for all classes in higher surveying; Church's Mechanics and Hydraulics; Merriman & Jacoby's Graphic Statics, Bridge Stresses, Bridge Design; Allen's Railroad Curves and Earthwork; Baker's Masonry Construction, Roads and Pavements; Johnson's Contracts and Specifications; Todd's Astronomy; Turneaure and Russell's Water Supply.

The total expenditure by the department during the year ending June 30, 1907, for all purposes has been $807.43, of which $73 was turned in by the department in fees for special examinations.

Respectfully submitted,

H. K. VEDDER,

Professor of Mathematics and Civil Engineering.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE WOMENS' DEPARTMENT.

To the President:

The past year the womens' department has been under the care of Miss Elizabeth S. Jones, who served as acting dean during the partial leave of absence granted to the dean at the September meeting of the State Board. We were exceedingly fortunate in securing Miss Jones, whose fine training and wide experience, combined with her strong personality, were such as to command the confidence of the college community at once. She took up the work with enthusiastic interest and carried the duties of the office with marked success. Her influence was most helpful and will long continue to be felt.

The high standard of the domestic art department has been maintained throughout the year. The training of students for teaching, by giving them opportunity to act as laboratory assistants, was emphasized and a number of the advanced students gave several hours a week to the work either in sewing or in wood work. The progress made and results secured are such as to command the plan most heartily. Mrs. Haner was assisted by Miss Bemis as heretofore, in the conduct of her large classes.

Miss Waugh and Miss Bemis have managed the work in domestic science and the department dining room. These duties are arduous and exacting but the comfort of the household depends largely on their successful performance. We wish to express our appreciation of the thought and care shown in this direction. Miss Waugh's resignation was generally regretted for she had become very popular in her brief stay.

The music department gave several recitals during the year and a

splendid concert, Mendelssohn's oratorio, "Elijah," as part of the Semi-Centennial celebration. All this involves special effort on the part of the head of the department and Miss Freyhofer deserves great credit for the fine work done. Her assistant the past year has been Miss Thorburn.

Miss Grace E. L. Chapman in charge of the gymnasium has held the work to its former interest and value. The "Oak Chain March" of the young women on student night, for which they had been drilled in the gymnasium, was a much praised feature of the recent celebration. Field hocky was introduced in the spring term as part of the work in physical training.

Several pieces of statuary have been added to the equipment, among them a large statue of Minerva; A beautiful bas relief—an Alexandrine Procession—now hanging in the large parlor was a gift from the College Woman's Club, and we wish to take this opportunity to record the appreciation and thanks of the department for this gift.

The Semi-Centennial was an occasion which called for extra service from teachers, employes and students alike. The general response to this need and the co-operation of all concerned is a matter for comment and gratitude.

In closing this report the dean desires to express her thanks to the Board and the President for the year's leave of absence and to her co-workers for their helpfulness and united efforts for the welfare of the department.

Respectfully submitted,
MAUDE GILCHRIST,
Dean of Women's Department.

Agricultural College, Mich., June 30, 1907.

REPORT OF DEPARTMENT OF ENTOMOLOGY.

President J. L. Snyder:

Following is a brief report of work done by the department of entomology during the year 1906-7.

Since the organization of the department of etomology as a separate department, in June, 1906, the work has been, for the most part, concentrated along two lines—viz.: Instruction to classes and work on the large collection. Instruction has been given this year in four courses; in the winter term a course on forest insects for seniors in forestry, and in the same term a course of thirty lectures on fruit insects for short course men in horticulture. Besides this several lectures were given to the second year men in live stock. In the spring term the regular introductory work in entomology was given to the agricultural sophomores and the regular work in fruit insects to the juriors who elect horticulture.

The collection of insects has received a good share of attention during the year, since August, when it was delivered to this department. A very considerable part of the collection still remained on cork and in

order to add new material it was necessary that that part of the collection be remounted on wooden blocks in accordance with the plan adopted and well advanced some years ago. This is very careful and tedious work when once done it is the most permanent method in use in collections of this work. This work is still being carried forward speedily.

There is a large accummulation of material collected in Prof. Cook's time and subsequently. Much of this has been brought together and sorted out and everything carrying information or serving as a record in any way, has been segregated out for permanent mounting, so far as we have gone. Much remains to be done in this line.

A large amount of material has been collected or bred and mounted ready to interpolate in its proper place as soon as the main collection is ready to receive it, the effort being to complete sets of the different stages illustrating life histories. Such sets are most instructive and few collections are supplied with good series of such material.

As a separate collection many specimens have been collected and mounted so as to safely handled. These are for use as hand specimens to be passed around in class work. We are constantly adding to this set and find it one of the best aids at our command in the class room.

It remains to extend our sincere thanks to Mr. E. J. Kraus who has been mose efficient and helpful in carrying on the work of the department, both in the laboratory instruction and in the work of rearing and preparing specimens, and to Miss Catherine Koch for her painstaking care in mounting the specimens in the collection.

Very respectfully submitted,

R. H. PETTIT,

Professor of Entomology.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE LIBRARIAN.

To the President:

Sir:—The following is the report on the library for the year ending June 30, 1907. Additions to the library during the year has been as follows:—By purchase, 657; by binding, 451; by gift, 245, total 1,353 bound volumes.

Of pamphlets and unbound volumes; by purchase, 40; by gift, 467; total 507. All pamphlets and unbound volumes were acknowledged when received, whenever donor was known; individual mention is therefore omitted.

For gifts of bound volumes we are indebted as follows:

Abbott, Francis R., 1.
American Shorthorn Breeders' Ass'n, 1.
Burrows, Hon. J. C., 1.
Bailey, Liberty H., 1.
Canadian Reports, 9.
Colorado Reports, 1.
Columbus Horticultural Society, 1.
Fletcher, Dr. S. W., 2.
Iowa Horticultural Society, 12.
Iowa Dept. of Agriculture, 1.
Jenison, L. F., 1.
"Jews in America," History of.
Kansas Reports, 1.
Koch, D. T. W., "Hinsdale's History of the University of Michigan."
Kell, Major, 1.
Mass. State Board of Agriculture, 1.
Mass. State Board of Health, 1.
Mass. State Labor Bureau, 29.
Missouri Horticultural Society, 3.
Missouri Botanical Gardens, 1.
M. A. C. Prohibition Club, 3.
Michigan, State Reports, 64.
New Jersey Reports, 11.
N. J. Horticultural Society, 1.
N. Y. State Library, 6.
N. Y. State Museum, 4.
National Board of Corrections and Charities, 2.
Oklahoma Reports, 1.
Penn. R. R. System, 1.
Smithsonian Institution, 15.
United States Reports of Bureau and departments as follows—
Dept. Agriculture, 4.
  Census, 10.
  Education, 1.
  Geological Survey, 2.
  Interior, 5.
  Interstate Commerce Commission, 2.
  Industrial Commission, 1.
  Labor, 4.
  Marine Hospital, 3.
  Navy, 2.
  State, 7.
  Treasury, 6.
  War, 2.
Wood, Mrs. A. M., 1.
West Virginia, 1.
Wisconsin, 5.

Two hundred twenty-six peridocials are purchased by the college and placed in the reading room for the use of the faculty and students. Of these one hundred twenty-three are published in this country, and one hundred three are foreign publications. In addition to these are the following, received either in exchange or through the courtesy of the publishers:

Adrian Times.
Agricultural Advertising.
Agricultural Gazette, New South Wales.
Agricultural Students Gazette, England.
Allegan Gazette.
American Dairyman.
American Grange Bulletin.
American Missionary.
American Society of Civil Engineers Proceedings.
American Swineherd.
American Thresherman.
Ann Arbor Argus.
Arboriculture.
Armada Graphic.

Battle Creek Journal.
Bear Lake Beacon.
Belding Banner.
Big Rapids Herald.
Boys and Girls.
Canadian Horticulturist.
Capitol City Democrat.
Chicago Daily Drover's Journal.
Chicago Packer.
Christian Herald.
Christian Science Journal.
Christian Science Sentinel.
Church Helper.
Civic News.
Congressional Record.
Cornell Countryman.
Electrical Times.
Engineering World.
Farm and Fireside.
Farm and Floral World.
Farm and Home.
Farm News.
Farmers' Advocate.
Farmers' Guide.
Farmers' Review.
Farmers' Tribune.
Farmers' World.
Farming.
Florists' Exchange.
Fruit Grower's Journal.
Gleanings in Bee Culture.
Good Health.
Grand Ledge Independent.
Hillsdale Leader.
Hillsdale Standard.
Hoard's Dairyman.
Holstein Friesian World.
Home and Farm.
Homestead.
Horseshoer's Journal.
Horse World.
Horticultural Visitor.
Improvement Era.
Indian's Friend.
Indiana Farmer.
Ionia Sentinel.
Johns Hopkins University Circulars.
Journal of Agriculture, Australia.
Journal of Agriculture, Victoria.
Kalamazoo Telegraph.
Kansas Farmer.
Kimball's Dairy Farmer.
Lansing Journal.
Lawton Leader.
Lewiston Journal.
Light.
Livestock Journal.
Livestock Report.
Mark Lane Express.
Michigan Mirror.
Michigan Presbyterian.
Midland Republican.
Moderator Topics.
Mystic Worker.
New Voice.
New York Meteorology. (Draper's Hourly Readings.)
New York Produce Review.
Official Gazette U. S. Patent Office.
Owosso Press American.
Petoskey Independent.
Practical Farmer.
Proceedings of the American Philosophical Society.
Publicity Magazine.
Republic.
Rural Advocate.
Saginaw Evening News.
Southern Farm Magazine.
State Republican.
Stockbridge Brief.
Traverse Bay Eagle.
Wallace Farmer.
Weather Review, U. S. Dept. Agri.
Western Society of Engineers. Journal.
Western Swine Breeder.
Williamston Enterprise.
Wilson Bulletin.
Women's Home Companion.
Writer.
Ypsilantian.

The M. A. C. Record exchanges are also placed in the reading room, and in exchange for our catalogue we receive the catalogues and registers from all of the leading institutions of the country, and the publications of the various state experiment stations, and of the United States department of agriculture.

The library hours have remained unchanged during the year. Fines to the amount of $18.76 have been collected.

To the library of the experiment station one hundred thirty-one volumes have been added, six by purchase, one hundred one by binding, and twenty-four by gift. Total number of volumes in this library, 2,397. In the college library are 25,720 volumes. Total in both libraries, 28,117 volumes.

We take pleasure in commending the work of our assistant, Miss Feldkamp, who has at all times given to the library her best efforts.

Our work has been greatly hampered by lack of room, and we take occasion to thank the members of the faculty and the students for their patience and kindness under conditions which though trying in the extreme, have been unavoidable. We hope the crowded condition may soon be relieved.

Respectfully submitted,
LINDA E. LANDON,
Librarian.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF DRAWING AND DESIGN.

To the President:

Owing to the extended leave of absence granted to Prof. Holdsworth, and in response to your request I respectfully submit the following report for the year ending June 30, 1907.

Following the resignation of Mr. H. G. Walker, instructor in Mechanical drawing, Mr. Frank M. Gracey was selected to succeed him. Mr. Gracey is a graduate of the Mass. Normal Art School, and came to us prepared to teach both free-hand and mechanical drawing.

The work for the fall term was apportioned in the usual manner between Prof. W. S. Holdsworth, Miss Caroline Holt, Mr. F. M Gracey, and myself. Early in December, Prof. Holdsworth was compelled to give up his college work, owing to failing health. The work of the department was completed in the best manner possible by the remaining force, and in response to action of the State Board Prof. Holdsworth left for Florida, late in the month.

For the winter term Mr. Lee M. Watson, another Mass. Normal Art School graduate, was engaged. The department was placed in my hands at this time, by action of the Board, until July first. I was very grateful for this recognition of past services, and the attending salary, as I wrote you at the time. The work of the term was carried out without unusual incident. I would most heartily commend the work of Mr. Watson, who came to us for three months only. It is interesting to note that not a single class period was omitted during the term. This is an unusual record as during the winter months, illness so often interrupts class work more or less.

The spring term was handled by Mr. Gracey, Miss Holt, and myself, with the exception of one class of women, which was taken by Mrs. Gracey, who was another Normal Art student. Her assistance was most satisfactory. During the term I have been planning the new equipment for our rooms in the new building, and have corresponded with dean Bissell and Professor Holdsworth, in regard to many of the features of this matter. I have also engrossed the diplomas of the graduating class as usual, and also the honorary diplomas granted at the semi-centennial celebration, (a total of 112).

Additional details of the class work of the year are given in the following tabulated statement:

Drawing classes.

Class.	Subject.	Teacher.	Hours.	No. Students.
Fall term, 1907.				
Sub-freshmen, W., 1a	Free-hand drawing	Miss Holt	5	20
Sub-freshmen, E., 4a & c	Fh. & Mech'l drawing	Mr. Gracey	6	33
Sub-freshmen, E. 4a& c	Fh. & Mech'l drawing	Mr. Newman	6	37
Freshmen, Ag. 1a	Free-hand drawing	Prof. Holdsworth and Miss Holt.	5	50
Freshmen (1) Eng. 4a & b	Fh. & Mech'l drawing	Mr. Gracey	6	36
Freshmen, (2) Eng. 4a & b	Fh. & Mech'l drawing	Mr. Gracey	6	36
Sophomore W. 1d	Charcoal drawing	Miss Holt	4	24
Sophomore (1) Eng. 5b	Descriptive geom	Mr. Newman	5	24
Sophomore (2) Eng. 5b	Descriptive geom	Mr. Newman	5	19
Sophomore (3) Eng. 5b	Descriptive geom	Prof. Holdsworth	5	31
Junior Engineers, 6	Topographical drawing	Prof. Holdsworth	6	30
Totals	(Instructors, 4)	(Sections, 11)	59	340

Drawing classes.—Continued.

Class.	Subject.	Teacher.	Hours.	No. Students.
Winter term, 1907.				
Sub-freshmen Ag. 1b	Free-hand drawing	Miss Holt	5	18
Sub-freshmen (2) Ag. 1b	Free-hand drawing	Miss Holt	5	20
Sub-freshmen (1) Eng. 4d	Mechanical drawing	Mr. Watson	10	30
Sub-freshmen (2) Eng. 4d	Mechanical drawing	Mr. Newman	10	34
4-year freshmen (1) Eng. 4e	Mechanical drawing	Mr. Gracey	10	35
4-year freshmen (2) Eng. 4e	Mechanical drawing	Mr. Watson	10	27
4-year freshmen (1) Ag. 1a	Free-hand drawing	Mr. Gracey	5	27
4-year freshmen (2) Ag. 1a	Free-hand drawing	Miss Holt	5	29
5-year freshmen (1) Eng. 4f	Machine drawing	Mr. Newman	6	20
5-year freshmen (2) Eng. 4f	Machine drawing	Mr. Newman	6	20
Sophomore Women 1e	Charcoal drawing	Miss Holt	5	22
Junior Engineers 7	Perspective, shades and shadows	Mr. Gracey	8	28
Totals	(Instructors, 4)	(Sections, 12)	87	310

Drawing classes.—Concluded.

Class.	Subject.	Teacher.	Hours.	No. Students.
Spring term, 1907.				
Freshmen Ag. 1b	Free-hand drawing	Miss Holt	5	20
Freshmen Women 1b	Free-hand drawing	Mrs. R. S. Gracey	5	28
Freshmen Women 1a	Free-hand drawing	Mr. F. M. Gracey	5	20
(1) Freshmen Engs. 5a	Descriptive geom	Mr. F. M. Gracey	6	33
(2) Freshmen Eng's 5a	Dercriptive geom	Mr. F. M. Gracey	6	32
(3) Freshmen Eng's 5a	Descriptive geom	Mr. Newman	6	46
Sophomore Women 1g	Mechanical drawing	Mr. Newman	4	24
Junior Women 3	History of Art	Miss Holt	5	20
Seniors and Specials	Landscape drawing	Mr. Newman	5	4
Totals....(Instructors, 3 full time, and 1 for 5 hours class work.)		(Sections, 9)	47	227

Respectfully submitted,

CHACE NEWMAN,

Assistant Professor of Drawing.

Agricultural College, Mich., June 30, 1907.

THE REPORT OF THE DEPARTMENT OF HISTORY AND ECONOMICS.

To the President:

There have been enrolled in the department of which I have charge during the past year, 560 students. These enrollments are distributed as follows: By terms, Autumn, 173; winter, 207; spring, 275. By classes, sub-freshmen, 60; freshmen, 33; sophomores, 141; juniors, 162; seniors, 146; specials 18. By subject, history, 275; political science, 143; political economy, 175; education, 67.

The number of courses presented by this department during the year was 20 and the total number of hours taught was 1104.

The large choice of text-books at the disposal of the teacher of any one of the subjects included within this department makes the use of these accessories very tempting and I add a list of the most important used: Channing's Students' History of the United States; Hart's Actual Government; Fetter's Principles of Economics; Ashley's American government; Cheney's Industrial and Social History of England; Cheney's History of England; Johnson's American Railway Transportation and Ely's Socialism and Social Reform.

The work in Education which constitutes the recently introduced Teachers' course for the young women was conducted the past year by Mr. Ryder of this department. Mr. Ryder also spent a week during January lecturing before farmer's institutes. An over-crowding of subjects in the spring term; largely the result of teaching the courses in education, necessitated the employment of additional help. Mrs. Minnie Hendricks, a former teacher in this department, was secured and her efficient services as well as those of Prof. Ryder are in every way to be commended.

Respectfully submitted,
WILBUR O. HEDRICK,
Prof. of History and Economics.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY.

To the President:

Sir:—I have the honor to submit herewith the annual report of the department of Zoology and Physiology for the year ending June 30, 1907.

The only change in the personnel of the department during the year has been the transfer of instructor R. H. Pettit to another department and the employment of Mr. J. R. Kelton in his place. The latter is a graduate of the Massachusetts Agricultural College, had one year's teaching experience before appointment here, and has done satisfactory work in anatomy, zoology and physical geography during the year.

The following schedule shows the arrangement of subjects, classes and instructors by terms. Laboratory work is required in almost all subjects and usually there are two or more divisions of each class for such work. When two or more instructors are named for the same class the one first named has had charge of the lecture or recitation work, the others assisting in the laboratory work.

SCHEDULE OF DEPARTMENT WORK, 1906-1907.

Fall Term.

- Anatomy 1. Five-year Agricultural Freshmen, 29 students (Meyers).
- Zoology 1. Agricultural Sophomores, 45 students (Barrows, Meyers, Kelton).
- Zoology 1. Women Juniors, 18 students (Barrows, Meyers, Kelton).
- Zoology 3. Agricultural Seniors, 16 students (Barrows, Meyers).
- Zoology 3. Women Seniors, 8 students (Barrows, Kelton).

Winter Term.

- Anatomy 2. Four-year Agricultural Freshmen, 49 students (Meyers, Kelton).
- Anatomy 2. Five-year Agricultural Freshmen, 25 students (Myers, Kelton).
- Zoology 2. Agricultural Sophmores, 43 students (Barrows, Meyers).
- Zoology 2. Women Juniors, 21 students (Barrows, Kelton).
- Geology 1. Agricultural Seniors, 17 students (Barrows).
- Geology 1. Women Seniors, 16 students (Barrows).
- Physical Geography 1. Sub-Frenchmen Women, 13 students (Kel-Kelton).

Spring Term.

- Anatomy 1. Five-year Women Freshmen, 13 students (Meyers).
- Anatomy 2. Women Sophomores, 29 students (Meyers, Kelton).
- Geology 2. Agricultural Seniors, 14 students (Barrows).
- Geology 2. Women Seniors, 10 students (Barrows).

Physical Geography 1. Sub-Freshmen Women, 13 students (Kelton).

Total number of students for the year, 423, an increase of 22 over last year.

In addition to the work outlined above a few students have been given instruction in methods of preparing and preserving biological material for study, especially the mounting of slides for the microscope and a little work in taxidermy. Such work is entirely voluntary on the part of the student and without credit on his course. The head of the department gave an illustrated lecture on birds at the annual meeting of the State Horticultural Society at Benton Harbor, in December, and has also given various talks, addresses and papers before schools, teachers' associations, clubs and other organizations.

In arranging the new course of study for the agricultural students two of the suggestions embodied in my annual report of last year (not printed) have been carried out in part, namely, the introduction of physicial geography and the addition of laboratory and fieldwork to the course in geology. The effectiveness of this latter course could be still further improved, as suggested last year, by the addition of a short course in blow-pipe analysis or determinative mineralogy such as is now given to the mechanical students. This would greatly enhance the value of the soil work given later in another department.

The question has often been asked why the college does not give a special course in ornithology in view of the fact that birds are recognized as among the most important agents in restricting insect increase and are universally regarded as among the most beneficial of created things. Particular point is given to this inquiry by the fact that during the past half dozen years a tremendous awakening has taken place along the lines of nature study, and bird clubs, Audubon societies and protective organizations have been formed all over the United States for the study, protection and encouragement of native birds. A required course in ornithology seems impracticable at the present time without cutting out some of the basic work now given, and this certainly is not advisable, but the new course will probably allow elective work along this line for both agricultural and women students.

Our distribution of collections of common Michigan insects to about one hundred of the best schools of the state, last year and the year before, has brought the department into correspondence with a large number of high schools and we have been called upon with increasing frequency to recommend text-books and collateral reading matter on insects and other natural history topics. Perhaps no part of the extension work of this department is of more importance than this advisory work in regard to the best guides in elementary science. These requests for advice come not alone from our own graduates, but from teachers trained in other schools, in the state and elsewhere, who are desirous of getting the best information as to the practical study of natural science.

About eight years ago the Board authorized the preparation by the Zoological department of a number of nesting boxes for birds of various kinds, and in compliance with instructions forty or more such boxes were prepared and placed in the best available positions about the campus with the expectation of attracting certain valuable birds especially

wrens, bluebirds, white-bellied swallows and purple martins. A preliminary report on this experiment will be found in my annual report for 1902, showing that almost immediately the wrens took advantage of these boxes and a marked increase in their numbers followed. This species has continued to increase in the most gratifying manner so that whereas in 1896 we knew of but two pairs nesting on the college campus, during the present summer (1907) not less than twenty pairs were nesting in the same area. Most of these wrens rear two broods each season, so that the campus is now fairly supplied with these delightful little songsters, and they are yearly becoming more abundant in the surrounding country.

In spite of all our efforts English sparrows occupied both the large martin houses erected on poles, and neither white-bellied swallows nor martins obtained a foothold for several years. This however was due in part to the location of the boxes, which had been relegated to obscure places among tall trees so as not to be conspicuous. Three years ago the spruces surronding one of these boxes were beheaded and trimmed so as to allow free access, and almost immediately two pairs of martins occupied two of the compartments and at least six young were reared. The following spring 12 or 14 pairs took possession of the house and reared their young without accident, and during the present summer almost every compartment (nearly thirty) was occupied.

As yet no white-bellied swallows have been induced to nest on the campus, but the fact that a single pair nested in a box on a fence-post in the orchard indicates that if the English sparrows could be properly reduced in numbers the swallows might return in numbers.

The facts with regard to the bluebird are less encouraging. They appear in numbers each spring and frequently inspect nesting-boxes, some of which are occupied by sparrows and some empty. After a while however they disappear, and so far as we can learn not a single pair has nested on the campus during the last ten years. There have been nests however each season in boxes a few hundred yards off the campus, as well as in orchards in the adjoining grounds, and some other explanation than the presence of the English sparrows would seem to be necessary. After careful investigation we feel confident that the absence of the bluebird is due in large part to the red squirrel, which is abundant all over the college campus and is an inveterate enemy of all birds which nest in natural cavities or in boxes. Whenever a nesting box is hung or nailed on a tree the squirrels find it and eventually destroy the eggs or young. When placed upon a building in such a position that squirrels cannot reach it the English sparrow recognizes the superiority of location and takes and holds the box with the utmost tenacity. We are loth to recommend the extermination of the squirrels, yet in view of the fact that they eat large numbers of robins, catbirds, chipping sparrows and other valuable birds each season it seems unwise to permit them to multiply unchecked. At present their only serious enemies appear to be domestic cats, which are far too numerous, and screech owls, which are far from abundant. The latter of course deserve protection, since they eat large numbers of mice of various kinds and also prey regularly on English sparrows, but the time is not far distant when the cat problem will compel attention. In the writer's opinion it is not too soon now to enact a statute requiring owners to

license cats in the same manner as dogs, and to begin a vigorous crusade against all cats not so licensed. Cats are of little or no use against rats, and the mice could be more satisfactorily combated with traps and poison. The average cat catches neither mice nor English sparrows, but does catch considerable numbers of valuable wild birds, especially such as would otherwise become abundant, confiding and useful about our gardens and lawns.

Respectfully,
WALTER B. BARROWS,
Professor of Zoology and Physiology.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE MILITARY DEPARTMENT.

President J. L. Snyder:

Sir—I have the honor to submit my report of the military department for the year ending June 14, 1907.

During the fall and winter terms I have divided my time among the various organizations striving to learn the men and to observe the effort made by them individually. At the end of each half term and term I made a personal inspection of each organization and recorded the standing of each cadet, taking into consideration his attendance, military bearing and proficiency in drill. I feel satisfied with the result of my work for the year. I believe the increased interest and consequent improvement in the drill generally to be quite marked. The work of the crops is not up to that degree of efficiency which I desire, but which, I believe, it being gradually attained.

The spring term opened April 2, but on account of the unusually severe weather I have been very much handicapped in my out-of-door work. The band this year has been provided with a suitable hall for practice, also with a number of C. G. Conn's best instruments. As a musical organization the band has been very successful, being composed of twenty-five cadets playing the various instruments necessary for a band of this size. The band, however, lacks discipline, due to the fact that a student is leader. I recommend that the leadership be given to an instructor in College, having the required qualifications. I think such a man can generally be found.

The corps of cadets during the spring term has been reviewed and inspected by Adj. Gen. W. T. McGurren, Inspector General Carl Wagner and Col. Walter Rogers of the Michigan National Guard.

Capt. J. A. Penn, General Staff U. S. Army, inspected the corps May 22 last.

The military exercises ordered by the inspector were as follows:

Escort of the color, review, inspection, battalion drill, company drill in close and extended order, and drill for the hospital corps detachment. The corps was prepared to execute the following exercises, but was prevented by rain: Dress parade, guard mounting and signal drill.

The inspector stated that the corps made a very creditable showing,

395 cadets, all properly uniformed, were present, four being absent, sick, and two being absent without leave.

On May 31 the corps received the President of the United States, who complimented the corps on its excellent appearance.

I believe the military instruction as now prescribed, if properly carried out, to be of such extent and thoroughness as to qualify the average graduate for a commission as a lieutenant of volunteers.

The hour for drill comes in the afternoon from 5 to 6. In the spring term this hour is a good one, but in the fall and winter terms I believe the hour from 1 to 2 p. m. would be a better one for drill for various reasons.

Before closing my report, I desire to take advantage of this opportunity to express my appreciation of the good work done by the following senior officers: W. B. Allen, J. L. Baker, A. J. Carpenter, G. W. Dudley, S. B. Lilly, T. H McHatton, A. C. Pratt and O. C. Post.

Very respectfully,

F. W. FUGER,

Capt 13th Inf. Comdt.

Agricultural College, Mich, June 30, 1907.

REPORT OF THE DEPARTMENT OF PHYSICAL CULTURE.

To President J. L. Snyder:

I have the honor to present herewith the report of the Department of Physical Culture and Athletics for the year ending June 30, 1907:

The work has been carried on along the same general lines as in past years, consisting of outdoor work almost entirely during the early fall and spring, and general indoor work from November 1 to April 1.

In outdoor work, teams, representing the institution in all branches of athletics, have been developed and all had creditable records for the year. The football team was one of the strongest ever brought out in the institution; the baseball team was a representative one, while the state championship was won by the basketball, tennis, track and relay teams, respectively. In addition to developing and maintaining a representative college team in each branch of athletics, a special effort was made to interest as large a number of the students as possible in active exercise by arranging inter-class and inter-society contests in all sports. This branch of the athletic life of the college seems to come nearest the ideal in athletics, as it not only gives the benefit of active exercise and actual competition to a large number but fosters, as nothing else can, a healthy college spirit.

The indoor work, which is carried on in the Armory, consisted of the usual work with the dumb-bells, Indian clubs, wands, free arm work and work on the apparatus, while time was offered for the several indoor games, such as basketball, track athletics, wrestling, tumbling, etc. A majority of the young men took advantage of some of the work, but, as I mentioned in a previous report, I am unableto reach the young men who need the work most, as it is entirely optional, and the young

man who does not enjoy active exercise will not elect it. This can be remedied only by making some sort of physical training compulsory for a certain portion of the course, a remedy which is hardly practicable, however, while the department is obliged to take the time left by the military department, and while there is no hour set aside on the schedule for the work. There was also offered, three times a week, for six weeks, a course for students in the short courses and about seventy-five enrolled for the work and seemed to get much benefit and pleasure from it.

A considerable amount of money and attention has been expended on the athletic field during the year; the improvement on the track and the grading and seeding has continued, a foot bridge across the Red Cedar river was put in at the north end; while a cement culvert has been put in at the approach to the main bridge and the entire approach is being raised to the level of the bridge.

The athletic equipment was added to quite materially by the addition of new baseball and track suits throughout, an entire new set of regulation hurdles and many other smaller items. In all about five hundred dollars has been expended during the year from the funds of the student's athletic association in permanent improvements on the field and in permanent equipment. The department funds, which come entirely from the receipts of the bath house, have been used in keeping up the bath house and armory and in the general keeping up of the athletic field.

The bath house has been used very extensively during the year, about three-fourths of the young men electing to pay the fee for its use while every locker in the building, two hundred and seventy-five in number, has been in use throughout the year. As I mentioned in my last report however, I think the fee for the use of the bath house should be collected of all the young men. It is not large enough to work any hardship and under the present plan the poorer boys, who need the privilege and would get the most benefit from it, do not elect to pay the fee.

All of which is respectfully submitted,

C. L. BREWER.

Agricultural College, Mich., June 30, 1907.

REPORT OF DEAN OF SPECIAL COURSES.

President J. L. Snyder:

Below is my report as Dean of the Special Courses, for the winter of 1906-7.

These courses were advertised much as in former years but the advertising was more effective because of the greater number of former special course students gathered about the state. A census of the young men upon arrival demonstrated the fact that a majority of them came to the college at the solicitation of some former special student. The Grange, Farmers' Clubs, Gleaners, brought these courses to the attention of the members and some young people came because of the work of these organizations. The press both local and metropolitan made editorial mention of these courses and did effective work in arousing enthusiasm in the matter.

The training offered was along four general lines, general agriculture, creamery management, cheese making and horticulture. For some inexplicable reason the last named course has never been popular. During the eight weeks covered by these courses there were but five young men who devoted themselves primarily to horticulture. During the last two weeks an effort was made to bring together the mature fruit growers to take advantage of a special program arranged to be most helpful to them. The matter was extensively advertised but the number in attendance was very small.

Thirty vigorous young men who had taken the eight weeks course in general agriculture in the winter of 1905-6 returned in January 1907 for eight weeks of advanced work. Their attention was directed to special work in veterinary science, in stock judging, in soils and crops, fruit growing, plant life, butter making, bacteriology, poultry husbandry and something of the sciences, entomology, chemistry, physics and bacteriology. A wide election was allowed and each young man chose the studies which would be most helpful to him in his future work. In addition to the studies named above there was offered for the first time advanced work in rural engineering including a study of the farm motors.

Unlike institutions in other states this college brings to its halls young men who do not seem to be content with a reasonable amount of study per day. At the urgent solicitation of the young men of all the special courses, an arrangement was made whereby they received, three evenings in the week, instruction in parliamentary law and in the rights and obligations of farmers. This class was a large one and was taught by Prof. C. B. Collingwood who was able to arouse intense interest in the subject and to secure a very noteworthy advance in ability to control an audience. This instruction is bound to be of unique value to these young men who return to their homes to be leaders in rural communities. It gives them self poise, an ability to control their thoughts and to decide correctly the questions of parliamentary law which are bound to arise in every organization.

Upon the studies of the course in general agriculture, first year, there

was an attendance of ninety-one. Our class rooms and laboratories are too small to handle so large a class. It was necessary to divide it into sections and to repeat the practical work. This made unexpected and in fact, unreasonable demands upon the time of the teachers of stock judging and of carpenter and blacksmith shop work. Before another winter sets in larger class rooms will be available and much of this repetition will be avoided. No changes have been made in the general plan of the teaching in this special course. The day is very full beginning at eight in the morning and the work continuing without interruption until five in the afternoon.

It is significant of the industry of these young men, unaccustomed to classroom and laboratory work, after the exhausting labor of a full day elected to fill up the closing hour with military drill. They entered into the spirit of the military work with intense enthusiasm. It was a hard trial on their physical endurance to begin at eight in the morning and close at six in the evening with one hour alone allowed for dinner.

I am happy to report that the examinations at the close of the term revealed very satisfactory progress indeed on the part of these students. A very large minority of them were graduates of high schools. They were therefore not ignorant of methods of study, though somewhat unaccustomed to devoting the whole day to this class of work. The very satisfactory progress was therefore to be expected.

The attendance upon the creamery course was smaller this year than in some previous ones, the roster including but forty-one names. The work proceeded along the usual lines, laying special emphasis on the bacteriological side, including the making and carrying forward of starters. Already nearly half of the creamery men in the state have been pupils at this dairy school. Their success or failure, however, does not hinge primarily on the knowledge received here but upon those personal characteristics of energy, persistence, thrift, cleanliness and business sense, which are the universal foundation stones of a successful business career. The school has sent out many a man well trained in the art of butter making and not poorly educated in the science upon which that art rests but who ignominiously fails because naturally dirty, slovenly and negligent or because lacking in energy and push. The school disclaims all responsibility for these defects.

Prof. F. O. Foster had charge of the practical work in butter making and was most ably assisted by Mr. McFeeters of Owen Sound, Can., whose ingenuity in developing methods of illustration combined with his broad knowledge and wide experience made him invaluable in the classroom and laboratory. A second assistant was Mr. Jay Pullen of Leslie, Mich. He was a formed student of the school and understood thoroughly both our methods of teaching and the business of handling cream and butter.

The cheese course was conducted by Prof. Foster. There were nineteen young men in that course. Most of them came from cheese factories to which they returned at the conclusion of the course. They were greatly benefited by the instruction in bacteriology and in milk testing as well as by the work at the vat.

No fundamental changes are suggested for the coming year. The courses are now moving by the inertia of their past history. The large number of young men, now approximately fourteen hundred which

have attained these courses, are their best advertisement. They are growing more and more useful to the state and are becoming one of the important features of the college week.

C. D. SMITH,
Dean.

Michigan Agricultural College, June 30, 1907.

REPORT OF THE SUPERINTENDENT OF FARMERS' INSTITUTES, 1906-7.

To the President:

Sir:—The farmers' institutes held during the past year have shown an increased interest in such gatherings in nearly all of the counties. The number of the so-called County Institutes has been seventy. This provided one for nearly every county of the Lower Peninsula and for ten of the counties of the Upper Peninsula.

Although the winter season as a whole was quite favorable to the securing of a large attendance, severe storms and bad roads considerably reduced the attendance in quite a number of counties and it so happened that these unfavorable conditions prevailed during one or two weeks in which the largest number of meetings were held. For a number of years the meetings in the more southern counties have, for the most part, been held during the month of February, but as for several seasons the weather was very unpleasant during the early part of the month, a desire was expressed for meetings to be held the latter part of January. It so happened this year that the weather at that time was much more stormy than during February and the change not only resulted in reducing the attendance, but it made it impossible to give as good satisfaction in the way of speakers as would have been the case had the meetings been extended over a longer period. Fully one-third of the county institutes were held during the last ten days in January and as a large number of one-day institutes were scheduled for the same time, it was not possible to furnish speakers asked for by many of these counties, as certain ones were desired upon the same day by half a dozen or more counties.

With few exceptions these institutes have lasted for two days each but in a number of cases, including Manistee, Barry, Berrien and Oakland, three day institutes were held, while in other counties it was preferred to hold the meetings only one day for the county institute and thus secure an increased number of regular one-day institutes.

The number of one-day institutes has been two hundred fifty-nine, which is two greater than the previous year and the number would have been fully three hundred had it been possible to grant the numerous requests for an increased number of institutes assigned to the county.

The success of both local and county institutes was due largely to the attention given by the officers of the county institute societies in whose hands local arrangements were placed. On the other hand, in

a few cases where it was supposed that the local arrangements had received proper attention, it was found, when the speakers reached the places where meetings were to be held, that the advertising had, for one reason and another, been neglected and on this account the attendance was greatly reduced.

While it cannot be said that the best results have been secured in counties where the secretary has received a small percentage of the amount collected for advertising and in the way of membership fees, as a partial recompense for the time spent in arranging institutes, this in many counties gave excellent results. On the other hand, too much praise cannot be given the secretaries and other officers in counties where no salary whatever has been paid and where the meetings, of course required the expenditure of considerable time in making the local arrangements.

The attendance has varied considerably in some of the counties as compared with previous years. This has been due in some cases to the fact that the weather may have been either more or less favorable than last year but it has generally resulted from the fact that many of the meetings have been placed at points where institutes have not been held before and where, as the people knew little regarding the aims and objects of the meetings, they took less interest than would have been the case at points where institutes had been held previously.

The speakers have for the most part been the same as in previous years, although a few persons have been added to the force. Although some were undoubtedly handicapped by being unfamiliar with the methods used in conducting meetings, the recruits have, in the main, given excellent satisfaction and in another year will be able to take their places with the more experienced speakers. Several of those added to the lecture force are graduates of the Agricultural College who have demonstrated upon their own farms the correctness of the principles learned while in college and whose training has fitted them for taking up institute work.

At the close of each meeting reports are sent in by the president and secretary of the county institute society, the chairman of the Women's section and others regarding the interest taken in the various topics and the impression made by the speakers. With a very few exceptions the reports have been very favorable. In many instances such comments as, "We shall be glad to have any of them with us again," "The speakers were all satisfactory," "I heard only favorable comments." "Everybody delighted with the speakers." "They were all good and the farmers were well pleased," and "They are first class. If they are asked a question they cannot answer, they say so" were sent in.

As in previous years the work of carrying on institutes has been greatly assisted by the members of the faculties of the various normal schools and the state university, who have frequently given their time. Among those who have been especially helpful are: Professor Filibert Roth of the State University, President L. H. Jones, Doctor N. A. Harvey and Professor Laird of the State Normal College, Principal C. T. Grawn and Professor Keeler of the Central Normal School, Principal D. B. Waldo and Professor Ernest Burnham of the Western Normal School, Principal Clarence E. Holmes of the School for the Blind, Honorable D. E. McClure, Deputy Dairy Commissioner Colon C. Lillie and

Honorable Charles W. Garfield of the State Forestry Commission were upon the programs at several places.

The success of the one-day institutes in Barry county at which the county commissioner of schools co-operated by furnishing a speaker for the afternoon and evening sessions during the institute season of 1905-1906 led to the adoption of the same plan in a large number of other counties. In some cases the speakers were from other counties, or even from outside the state as was the case in Wayne county, where commissioner O. J. Kern of Rockford, Illinois was secured for the entire series and also for the county institute. In other counties assistance was secured from the various normal schools, or the commissioner of schools from some of the neighboring counties was secured to attend the meetings. Where this was not done, the local county commissioner of schools was upon the program at many of the institutes and, with very few exceptions, they gave their hearty co-operation and aided the secretary of the county institute society in advertising the meeting and in making the local arrangements.

The result secured in previous years from having at least one speaker from some of the adjoining states was so satisfactory that arrangements were made this year to obtain Mr. Jasper P. Davis of Sheridan, Indiana for two weeks during the month of January. Mr. Davis had for several years formed one of the corps of institute lecturers in Indiana and came with high recommendations from Supt. W. C. Latta of that state. During his stay in Michigan he spoke in nine counties, in all of which he gave the best of satisfaction. For the most part his topics related to the improvement and cultivation of corn but he also spoke upon stock farming vs. grain farming and upon the farm home as evening talks.

During the year eighteen members of the college faculty have assisted at the institutes. For the most part they have devoted but one or two days each to the work but several have attended from five to eight meetings. The total number of days devoted by members of the faculty to attending the regular institutes has been fifty-seven and a total of forty-three days was given to the railroad institutes and eighteen to the round-up institute. The assistance rendered by the members of the college faculty and the staff of the experiment station has been considerably less than in previous years owing to the increase in the number of students, particularly in the short courses which are given at the time the institutes are held.

The annual Round-up Institute was held at Ionia upon the invitation of the Ionia County Farmers' Institute Society at the close of the regular series. The weather during the week was very favorable and there was a large attendance, not only from Ionia county, but from all parts of the State. The number present at several of the sessions ranged from 1,400 to 2,000 persons and the opinion was generally expressed that it was the most successful meeting of its kind ever held in the State.

During the week several conferences of delegates from the county institute societies and the institute lecturers were held, at which the work of the past year was discussed and plans made for carrying on the work during the coming year.

There was a general desire for an increase in the number of institutes and for a larger equipment in the way of charts and models for the use

of the institute lecturers. In order that this might be secured, a motion was unanimously passed asking the State Board of Agriculture to set aside $12,000 for Farmers' Institutes in 1907-8. This was also included in the report of the Committee on Resolutions, and was adopted without a dissenting vote.

Aside from those referred to above, the following have acted as farmers' institute lecturers during the year:

Alvord, Chas. H., Camden.
Cannon, H. B., Rochester.
Cook, A. B., Owosso.
Dean, M. L., Napoleon.
Clapp, N. A., Northville.
Edmonds, J. F., Hastings.
Farrand, T. A., Eaton Rapids.
Garfield, Hon. Chas. W., Grand Rapids.
Geismar, L. M., Chatham.
Gray, A. P., Traverse City, No. 1.
Hopkins, Arlie L., Bear Lake.
Hull, N. P., Dimondale.
Hutchins, J. W., Hanover.
Ladd, E. O., Old Mission.
Moore, E. M., Orchard Lake.
Moore, N. I., Hanover.
Osborne, Morley E., Lansing.
Oviatt, L. W., Bay City, R. D.
Potter, N. K., Bancroft.
Raven, W. F., Brooklyn.
Reynolds, P. B., Owosso.
Schlichter, Wesley, Brown City.
Sherwood, R. H., Watervliet.
Stearns, J. N., Kalamazoo.
Taylor, W. F., Shelby.
Towar, J. D., Agricultural College.
Tyler, Comfort A., Nottawa.
Voorheis, Peter, Pontiac.
Waldron, Dr. C. A., Tecumseh.
Woodman, Jason, Paw Paw.
Barber, Mrs. C. L., Lansing, Washington Avenue South.
Barnum, Mrs. G. H., Charlotte.
Bogue, Mrs. E. E., Agricultural College.
Buell, Miss Jennie, Ann Arbor.
Campbell, Mrs. Emma A., Ypsilanti.
Creyts, Mrs. E. J., Lansing, R. D.
Partch, Mrs. C. M., Armada.
Rockwood, Mrs. Ella E., Flint.
Saunders, Mrs. F. D., Rockford.
Sherwood, Mrs. Ada Simpson, Three Oaks.
Smith, Miss Mary L., Addison.

Respectfully submitted,

L. R. TAFT,
Superintendent of Farmers' Institutes.

Agricultural College, Mich., June 30, 1907.

REPORT OF STATE INSPECTOR OF ORCHARDS AND NURSERIES.

To the State Board of Agriculture:

Gentlemen—The following report for the year now finished is respectfully submitted:

The portion of my time devoted to this office has been about equally divided into three parts, the inspection of the nurseries of the state, the examinations of orchards for San Jose scale and other dangerous insects and diseases, and correspondence regarding the work of the department.

Of the seventy-eight nurseries of the state, I have personally inspected forty-eight, and have visited some of them two and three times. The nurseries that have received more than one visit have been those in which the San Jose scale or other trouble has been found. In order to save as much of the stock as possible it has been customary to go to the infested nurseries in the spring and make sure that the orchard and other trees in the vicinity are not harboring pests that will spread to the nursery trees. In cases where the San Jose scale has obtained a foothold, it has been customary to require the spraying of trees that are carried over the winter with the sulphur-lime mixture.

In the work of the department I have received the hearty and efficient co-operation of the deputy inspectors, who have been the same as last year. Mr. T. A. Farrand, of Eaton Rapids, inspected most of the nurseries in the southwestern section of the state, and also devoted considerable time to the inspection of orchards and holding of demonstration meetings; Mr. E. W. Allis, of Adrian, inspected the nurseries in Lenawee and Monroe counties and aided in the inspection of orchards in that section; Mr. H. G. Welch, of Fennville, inspected most of the nurseries in Allegan and Ottawa counties, and was in charge of the inspection work in those counties so far as the San Jose scale, yellows and little peach diseases were concerned; Mr. F. A. Wilken, of the South Haven sub-station, attended to most of the nursery inspection work in Kalamazoo county, and looked after the orchard inspection in Van Buren county; Mr. R. J. Stahelin, of Bridgman, as in previous years, inspected the small fruit plants for the nurseries in that vicinity, and gave considerable attention to the inspection of orchards in southern Berrien county; Mr. L. M. Geismar, of the Northern Peninsular sub-station, acted as deputy for that part of the state.

Owing to the fact that the nurseries in which the San Jose scale and other troubles were found in 1905, had all of the infested stock destroyed, and that which was left sprayed with the sulphur-lime mixture, the amount of infested stock was somewhat reduced as compared with that found the previous year. There is every reason to hope that by following out this plan and making sure that infested orchards in the vicinity are either destroyed, or thoroughly sprayed, the injury done by the scale in the nurseries will be greatly lessened. During the year the scale has been found to a slight extent in a few nurseries in which

its presence had not been previously detected. This, however was expected, as they were located in sections where the scale had been found in nearby orchards.

The fumigation of all nursery stock that has been grown in infested nurseries or within one-half mile of where the San Jose scale has been found, after destroying all trees upon which the presence of the scale can be detected reduces to a minimum the danger of spreading the scale upon nursery stock.

While it is probable that the San Jose scale has appeared in sections where its presence has not been noted, it is quite sure that its distribution in Michigan is much less than is supposed by many persons. It has never been found in the counties north of Oceana, Newaygo and Gratiot, and it is confined to one or two points in each of those named. Even in the southern part of the state there are several counties from which it has not been reported, and a number of others where it seems to be confined almost entirely to some of the larger villages and cities. In the counties of Berrien, Van Buren, Allegan, Monroe, Wayne and Macomb it has become quite generally distributed, although there are many townships in those counties in which it has not been found. In Ottawa, Kent and Oakland counties there are sections in which a larger portion of the trees are infested, but except in the cities and villages it has not become generally distributed in the other counties. From the above it can be seen that the counties in which fruit growing is most extensively pursued are those which have suffered most, while the sections in which general farming is the leading industry and the orchards are small and generally scattered have as yet been but little injured by the San Jose scale.

During the past year great progress had been made in combating the scale, particularly in the fruit belt, and by the commercial growers who fully realize the danger that threatens their orchards, and are prepared to destroy the foe. A large number of orchardists have erected steam cooking plants and are equipped either with power sprayers, or with barrel outfits that suffice for the purpose.

On the other hand many farmers who have but a few trees, and which they are growing with little care, do not realize the danger that threatens, and those who do consider the fruit of such small value that they do not care to go to the trouble and expense of securing a spraying outfit and treating the trees. This is also true in the towns and villages where the number of trees is often so small as to hardly justify the expense of a spray pump. Under both of these conditions the difficulty could be prevented if persons could be hired to spray the trees. This has been done in many cases, but even in sections where spraying has been practiced for years it is difficult to secure any one to take up commercial spraying.

Experiments during the last year have again conclusively shown that the sulphur-lime mixture is not only the cheapest, safest and most effectual remedy against the San Jose scale, but that it is worth all it costs as a fungicide for the control of the many diseases to which fruit trees are subject. Until some equally effectual remedy is found the use of the standard formula of sulphur and lime is recommended whenever trees are infested with San Jose scale. The tests made by the writer, as well as by hundreds of the leading fruit growers indicate that where

this remedy is properly prepared and thoroughly applied there is little difficulty in holding the scale in check. While it is necessary to go over the trees at least twice in order to make sure that every part is covered, one thorough application just before the growth starts in the spring will give even better results than two spraying such as ordinarily made which leave small portions of the trees without treatment. In California, where the scale has been at work for twenty or thirty years, it has been found that a thorough application once in three years serves to hold it in check.

The climate in Michigan is less favorable for the development of the San Jose scale, and it is probable that equally good results can be secured here, although the value of the sulphur-lime mixture as a fungicide may make it worth while to treat infested trees annually.

Some persons object to the use of this remedy owing in part to the fact that it has to be cooked before it can be used, and also on account of its caustic effect upon the skin. When equipped with a steam cooking plant and an elevated tank from which the mixture can be drawn directly into the spraying tank, there is no difficulty in preparing the mixture, and even when a kettle is used it is possible to prepare a sufficient quantity for a large orchard, the principal drawback being the necessity of dipping the liquid into the tank or barrel. It is in doing this one is most likely to smear the mixture upon the hands. If care is taken to use hose that does not leak and if there are gaskets upon the spraying rod to prevent it from running down on the hands the mixture can be used with but little more trouble than Bordeaux mixture. It is a good plan, however, to rub vasaline upon the hands, and by protecting the clothing by means of rain coats and covering the horses with canvas blankets the objections against the use of the sulphur-lime mixture will be largely removed.

The use of the so-called soluble oils has not given satisfactory results. Even when used at double strength the trees have been more thickly infested in the fall than before they were sprayed in the spring. At this strength the cost is about five times as great as when the lime-sulphur mixture is used.

Although far less injurious, there are several other scales upon orchard trees in Michigan. Among the most common upon apple trees are the oyster shell and scurfy scales. The apricot scale is also occasionally found upon plum trees. For these and similar insects the lime-sulphur mixture is less effectual than others that are more alkaline. The scales mentioned, during the winter and spring, consist of merely a thin shell covering a mass of eggs. By spraying infested trees with a solution of caustic soda or lye, using five or six pounds in sixty gallons of water, the shells will be loosened and the eggs will be washed off by rains.

The ravages of peach yellows have been almost entirely confined to the Lake Shore district south of Pentwater, although the disease has done some harm in Kalamazoo, Jackson and Washtenaw counties. There is no reason to consider it anything but a contagious disease, and, although it will quickly destroy every tree in the orchard if allowed to go undisturbed, by the prompt removal of infected trees, the loss can often be kept down to one tree in one thousand.

The "little peach" has been kept within even narrower bounds, but, although less is known regarding this disease, it is probable that it is

more to be feared than peach yellows, as it appears to be more virulent in its action. As with yellows, nothing has been learned regarding its nature, but while it perhaps cannot be controlled to the same extent, the losses from this disease can undoubtedly be kept within bounds by removing the trees in which the disease appears.

The black peach aphis and the woolly aphis upon the apple have done less injury than in previous years, owing perhaps to the fact that the summer has been unusually moist in most sections. The former does very little harm, except to young trees, and upon light soil. By fumigating infested nursery stock and treating orchard trees with wood ashes and manure to force the growth, this insect can be kept from doing serious harm. The same treatment also generally sufficies against the woolly aphis.

One of the leading drawbacks in securing effective action against the San Jose scale is the fact that few persons are able to detect it upon the trees and then, even though they are provided with a spraying outfit, they often fail to properly prepare the mixture or, what is more common, to take sufficient care in spraying the trees to cover the branches. In order that these difficulties might be corrected, arrangements have been made for a large number of demonstration meetings. Most of these were held in infested orchards, where there was an opportunity to show the appearance of the scale and the methods by which it could be detected. Arrangements were also made for preparing a quantity of the sulphur-lime mixture and applying it to the trees. These meetings were pronounced by those in attendance very helpful. In some instances the interest shown was all that could be asked, but in others parties having infested orchards and living within a few rods of where the meeting was held failed to attend, although they had no knowledge of the scale and lacked experience as to the preparation and application of remedies.

Under the best of conditions the San Jose scale will undoubtedly spread at least over the southern half of the state. It will unquestionably attack nearly all of the fruit trees and unless steps are taken to destroy it, the infested orchards will be ruined in from one to five years. In 1906 the spread of this insect, especially in the peach orchards, was very rapid. At the close of the season it was not uncommon to find entire orchards killed by the scale in which it had hardly gained a foothold in 1905.

While many thousands of trees will undoubtedly be destroyed by the scale within the next five years, fruit growers who keep a careful watch of their trees and spray them thoroughly as soon as the presence of the insect can be detected will not only be able to save their orchard, but the increased care in other ways which they will almost certainly give their trees cannot fail to add both to the quantity and quality of the fruit.

During the last ten years the fruit and forest trees of Massachusetts have been seriously injured by two insects known as the gipsy and browntail moths, and although the ravages of the former, which is the more destructive of the two, have been for the most part to an area a little larger than the average Michigan county, in order to hold it in check nearly one million dollars will be spent this season by the state and municipal authorities and private owners. Although the female gipsy

moth has little power of locomotion there is a possibility that it may at any time be brought to Michigan and, that it may be looked after before it has had time to spread, everyone should make himself familiar with its appearance and if insects of any kind appear that seem to be particularly destructive, samples should be forwarded to this office for identification.

In order to familiarize myself with its workings and the methods that had been found for controlling it I have during the past month, at my own expense, visited the sections of eastern Massachusetts where these insects have been especially troublesome. The results certainly are quite encouraging, and our present nursery and orchard inspection law is undoubtedly sufficiently broad to permit of the handling of these insects if, as is to be feared, they appear in Michigan.

Respectfully,
L. R. TAFT,
State Inspector of Orchards and Nurseries.

Agricultural College, Michigan, June 30, 1907.

LICENSES GRANTED FOR THE YEAR ENDING JULY 31, 1907.

Alferink, Alfred, Holland, No. 8.
Allen, R. E., Paw Paw.
American Nursery Co., Kalamazoo.
Augustine, L. D., St. Joseph.
Baldwin, O. A. E., Bridgman.
Battle Creek Nursery Co., Battle Creek.
Bragg, L. G. & Co., Kalamazoo.
Briscoe, J. A., Highland Park.
Central Michigan Nursery Co., Kalamazoo.
Clark, D. H., Holland.
Collins, W. E., Fennville.
Coryell, R. J., Birmingham.
Cross, J. A., Nunica, R. D.
Culver, O. B., Colon.
Curtis, L. T. & Sons, Flint, R. D.
Dean, George N., Shelbyville.
Dow, H. C., Kibbie, R. D.
Dressel, G. L., Frankport.
Dunham, E. W., Stevensville.
Dutton, Charles S., Holland.
Essig, W. W. & Co., Detroit, Jones Building.
Ferrand, E. & Son, Detroit, Vinewood Avenue.
Flansburgh & Potter Co., Leslie.
Grand Rapids Nursery Co., Grand Rapids.
Greening Nursery Co., Monroe.
Gustin, C. F., Adrian.
Haines, J. W., Eaton Rapids.
Hamilton, A. & Sons, Bangor.
Hart Nursery Co., Hart.
Haughey, J. H., Berrien Springs.
Havekost, G. H., Monroe.

Hawley, George A., Hart.
Hodges, Ezra & Son, Mayville.
Husted, N. P., Lowell.
Ilgenfritz, I. E. Sons' Co., Monroe.
Jaquay, Irving Co., Buchanan.
Jeffrey, James, Jr., Bronson.
Jeffrey, James, Sr., Kalamazoo.
Kaiser, John A., Eau Claire.
Kalamazoo Nurseries, Kalamazoo.
Kellogg, R. M. Co., Three Rivers.
Knight, David & Son, Sawyer.
Lake Shore Nursery Co., St. Joseph.
Lamson & Rood, Covert.
Maudlin, The E. Nursery, Bridgman.
McKee, H. R., Coloma.
Michigan Nursery Co., Monroe.
Michigan Nursery and Orchard Co., Kalamazoo.
Muchmore, Wm. O., Augusta.
Munson, W. K. & Son., Grand Rapids.
Muskegon Fruit Growing Co., Muskegon.
Negaunee Nurseries and Greenhouses, Negaunee.
Nelson, J. A. & Son, Paw Paw.
Newaygo County Nursery Co., Fremont.
Northwestern Nursery Co., Muskegon.
Paw Paw Valley Nursery Co., Coloma.
Peninsula Nursery Co., Benton Harbor.
Post Tavern Gardens, Battle Creek.
Prater, Germain E., Jr., Paw Paw.
Pontiac Nursery Co., Ltd., Detroit, 240 Woodward Avenue.
Prudential Nursery Co., Kalamazoo.
Sheldon, W. E., Litchfield.
Singer, W. H., Lapeer.
Smith, E. J., Cheboygan.
Speyers, Charles M., Willis.
Spielman Bros., Adrian.
Stone, John & Son, Hillsdale.
Taplin, Stephen, Detroit, W. Fort Street.
Thrasher, C. D., Hamburg.
Utter, Jay J., Bravo.
Watterson, W. J. & Son, Ada, R. D.
Webb, D. S. & Co., St. Joseph.
Weller, Barand H., Holland.
West Michigan Nurseries, Benton Harbor.
Weston, A. R. & Co., Bridgman.
Whitten, C. E., Bridgman.
Willis, Orville, Bangor.
Wise, Ralph, Plainwell, R. D.
Wooll & Tillotson, Elsie.

Michigan Dealers.

Beattie, Thomas, Detroit, 187 Sidney Avenue.
Cole, Levant, Battle Creek.
Clark, Thomas W., Detroit, 252 West Alexandrine Avenue.
Cutler & Downing, Benton Harbor.
Cook, R. B., Muskegon.
Davison Nursery Co., Davison.
Dodge, Thomas T., Lawton.
Dumphry, W. C., Sr., Battle Creek.
Hawley, H. E., South Haven.
Hudson, J. L. Co., Detroit.
Kimball, D. S., Detroit, 47 Aurelia Street.
Knapp, W. F., Monroe.
Kooyers, John A., Holland.
Maplewood Violet and Nursery Co., Lansing.
Merrill, W. F., South Haven.
Pearson, D. S. & Co., Grand Rapids.
Oregon Nursery Co., Detroit.
Shepard, Andrew G., Paw Paw.
Sodus Nursery Co., Sodus.
Souter, George H., Holland.
Strittmatter, Adolph, Detroit, 488 Chene Street.
Sweet, L. H., Carsonville.
Tossy, L. F. & Co., Detroit, 84 Baltimore Avenue.
Washington Nursery Co., Detroit.
Westgate Nursery Co., The H. L., Monroe.

Foreign Nurseries.

Albaugh Nursery Co., Phoneton, Ohio.
Allen Nursery Co., Rochester, N. Y.
Bogue, Nelson, Batavia, N. Y.
Bohlender, Peter & Son, Phoneton, Ohio.
Brown Brothers' Co., Rochester, N. Y.
Bryant Bros., Dansville, N. Y.
Bryant, Arthur & Son, Princeton, Ill.
Charlton Nursery Co., Rochester, New York.
Chase Brothers' Co., Rochester, N. Y.
Chase, R. G. Co., Geneva, N. Y.
Chase & Wyman, Rochester, N. Y.
Cline, J. B. & Son, Rochester, N. Y.
Costich, G. A. Co., Rochester, N. Y.
Dansville Nursery Co., Dansville, N. Y.
Davis, Franklin Nursery Co., Baltimore, Md.
Fairview Nurseries, Rochester, N. Y.
First National Nurseries, Rochester, N. Y.
Foster & Griffith, Fredonia, N. Y.
Glen Brothers, Rochester, N. Y.
Graham Nursery Co., Rochester, N. Y.
Griesa, A. C. Lawrence, Kansas.
Harman, M. H. Co., Geneva, N. Y.

Hawks Nursery Co., Rochester, N. Y.
Heikes & Poock, Troy, Ohio.
Henby, J. K. & Son, Greenfield, Ind.
Herrick Seed Co., Rochester, N. Y.
Home Nursery Co., Bloomington, Ill.
Hooker, Wyman & Co., Rochester, N. Y.
Jewell Nursery Co., Lake City, Minn.
Knight & Bostwick, Newark, N. Y.
McGlennon & Kirby, Rochester, N. Y.
North Jersey Nurseries, Springfield, N. J.
Olver Brothers, Rochester, N. Y.
Perry Nursery Co., Rochester, N. Y.
Sonderegger, Carl, Beatrice, Nebr.
Spaulding Nursery and Orchard Co., Springfield, Ill.
Spencer Seedless Apple Co., Toledo, Ohio.
Standard Nursery Co.. Rochester, N. Y.
Stark Brothers' Nurseries and Orchards Co., Louisiana, Mo.
Van Dusen Nurseries The, Geneva, N. Y.
Western New York Nursery Co., Rochester, N. Y.
Whitney, G. W. & Co., Dansville, N. Y.
Willett, Eugene, North Collins, N. Y.

TWENTIETH ANNUAL REPORT

OF THE

EXPERIMENT STATION

OF THE

STATE AGRICULTURAL COLLEGE OF MICHIGAN

UNDER THE HATCH ACT

FOR THE

YEAR ENDING JUNE 30, 1907.

For members and organization of the State Board of Agriculture in charge of the Station, and list of officers, see page 11 of this volume.

EXPERIMENT STATION.

REPORT OF SECRETARY AND TREASURER.

The following account shows the receipts and expenditures of the Experiment Station for the year ending June 30, 1907:

		Dr.	Cr.
July 1, 1906—	To balance	$4,130 01	
July 13, 1906	received from U. S. Treasury	10,500 00	
Oct. 11, 1906	received from U. S. Treasury	3,750 00	
Jan. 12, 1907	received from U. S. Treasury	3,750 00	
Jan. 19, 1907	received from U. S. Treasury	191 60	
April 8, 1907	received from U. S. Treasury	5,500 00	
June 30, 1907	license fees, 142 brands commercial fertilizers	2,840 00	
	farm receipts	1,533 59	
	from State appropriation, So. Haven	1,500 00	
	from State appropriation, U. P. Experiment Station	2,850 00	
	from State appropriation, U. P. Experiment Station, special	4,000 00	
	So. Haven Experiment Station, receipts	636 91	
	U. P. Experiment Station, receipts	1,188 34	
	from State appropriation for live stock	13,000 00	
	by disbursements as per vouchers filled in the office of the State auditor general		$54,896 54
	Balance on hand		473 91
		$55,370 45	$55,370 45

Forty-seven thousand copies of each regular station bulletins are now issued of which about forty-five thousand are required for the regular mailing list. Aside from these a considerable of special and press bulletins are issued each year.

DISBURSEMENTS ON ACCOUNT OF U. S. APPROPRIATION.

	Hatch Fund.	Adams Fund.	
Salaries:			
Director and administrative officers, No. employed 7	$2,871 89		
Scientific staff, No. employed 5	2,600 96	$1,316 90	
Assistants to scientific staff, No. employed 5	685 18	799 50	$8,274 43
	$6,158 03	$2,116 40	
Labor:			
Monthly employees	$3,149 92	$842 00	
Monthly, weekly, daily and hourly employes	2,285 23	591 60	
	$5,435 15	$1,433 60	6,868 75
Publications:			
Half tones, mailing list, etc	$250 16		$250 16
Postage and stationery:			
Postage	$263 28		
Stationery	194 92	$4 87	
Telegraph and telephone	19 87		
	$478 07	$4 87	482 94
Freight and express	$241 48	$69 87	311 35
Heat, light and water	$39 31		39 31
Chemical supplies	$148 08	$69 58	217 66
Seeds, plants and sundry supplies:			
Agricultural	$186 50	$12 36	
Horticultural	132 55	139 64	
Entomological	53 50		
Director's office	41 07		
Secretary's office	49 10		
Library	94 15		
Bacteriology	27 12	1,840 37	
Veterinary	85	18 78	
Chemical	64 93		
	$649 77	$2,011 15	2,660 92
Fertilizers	$173 96	$32 68	206 64
Feeding stuffs	$194 36	$155 26	349 62
Library	$167 05	$622 20	789 25
Tools, implements and machinery:			
Repairs	$23 95	$0 60	
New purchases	90 00		
	$113 95	$0 60	114 55
Furniture and fixtures:			
One rug	$18 49		
One vertical file	25 00		
One roll top desk	30 00		
One table	3 00		
One antique oak case	50 00		
Sundry items	15 00		
	$141 49		141 49

U. S. APPROPRIATION.—*Continued.*

	Hatch Fund.	Adams Fund.	
Scientific apparatus:			
One camera		$75 00	
Three copper lined electric ovens		193 50	
One Schreiner Colarimeter		15 00	
One autoclave		200 00	
Sundry items		1,076 87	
Twenty dissecting microscopes	$65 00		
One camera guide	15 30		
One Fertz sampling tube	8 00		
Sundry items	126 03		
	$214 33	$1,560 37	$1,774 70
Live stock:			
Cattle		164 40	
			164 40
Traveling expenses:			
In supervision of station work	$122 11		
In connection with investigations under Adams Act		$450 62	
For other purposes connected with station work	409 88		
	$531 99	$450 62	982 61
Buildings and lands:			
Repairs	$62 82		
			62 82
Total			$23,691 60

DISBURSEMENTS OF EXPERIMENT STATION—MONEYS OTHER THAN RECEIVED FROM UNITED STATES TREASURER.

Salaries	$2,119 14	
Labor	7,855 47	
Publications	97 22	
Postage and stationery	468 36	
Freight and express	719 31	
Heat, light, water and power	4 05	
Chemical supplies	11 00	
Seeds, plants, and sundry supplies	4,242 46	
Fertilizers	29 45	
Feeding stuffs	2,014 06	
Library	28 23	
Tools, implements and machinery	165 38	
Scientific apparatus	214 18	
Live stock	6,986 13	
Traveling expenses	1,418 12	
Buildings and land	4,802 38	
		$31,204 94
Balance on hand		473 91
Total		$31.678 85

REPORT OF DIRECTOR OF EXPERIMENT STATION.

President J. L. Snyder:

Permit me to hand you herewith the annual report of the Director of the Experiment Station for the year ending June 30, 1907. During that year the following bulletins were issued:

Bulletin 239—Fertilizer Analyses. A. J. Patten, Aug., 1906.

Bulletin 240—Roots Supplementary to Silage for Diary Cows. R. S. Shaw, Sept., 1906.

Bulletin 241—A Plan for the Improvement of Michigan Cattle. R. S. Shaw, Sept., 1906.

Bulletin 242—Feeding Whole Grain. R. S. Shaw, Oct., 1906.

Bulletin 243—Cull Beans as a Food for Swine. R. S. Shaw and A. C. Anderson, Nov., 1906.

Bulletin 244—Insects New or Unusual in Michigan. R. H. Pettitt, Dec., 1906.

Bulletin 245—Poultry Raising. J. G. Halpin, Jan., 1907.

Bulletin 246—Practical Use of Starters. C. E. Marshall, L. D. Bushnell and W. R. Wright, June, 1907.

Bulletin 247—Dried Beet Pulp for Fattening Steers. R. S. Shaw and H. W. Norton, April, 1907.

Special Bulletin 36—Spraying Calendar. L. R. Taft, March, 1907.

Special Bulletin 37—Spraying. L. R. Taft, March, 1907.

The resources of the experiment station have been greatly increased during this period, first by an appropriation of $30,000 by the legislature for use in live stock work; $10,000 for the erection of suitable buildings wherein the work could be conducted, and $20,000 for the conduct of the work itself. The expenditure of this fund has been judiciously done by Prof. Shaw. He has taken dairy cattle of the type found on Michigan farms, and tested the matter of breeding, feeding and selection, as well as the simple one of the record of the performance of a mediocre herd under optimum conditions. The results of this work are not yet published in their entirety, but the bulletins have been reports of progress for the most part. The first annual report of a grade dairy herd, for instance, gives the data in regard to the performance of that grade dairy herd in the first year of its existence. The work is still in progress, and later reports will indicate whether the somewhat remarkable performance of these cows under these excellent conditions are due to the sudden stimulation, or whether the similar excellent yields will be continued during the second and subsequent years of the life of the herd. In Bulletin 241 Prof. Shaw presented a plan for the improvement of Michigan cattle. This bulletin, like 238, was received by the farmers as a distinct contribution to the literature of breeding, and although 45,000 were issued, the supply is well nigh exhausted.

In the same way bulletin 245, being the first bulletin published since the reorganization of the poultry department, has had a call from all over the state, which indicates the deep interest on the part of the farmers in poultry raising. The other bulletins eminating from the farm department have been of technical character, reporting work on special

problems, such, for instance, as the proportion of the whole grain fed to animals of the cattle kind that may pass through the system unmasticated and therefore undigested, of the feeding of cull beans to pigs or of dried beet pulp to fattening steers. This work and the subsequent bulletins eminate directly from the appropriation made by the legislature of 1905. I am glad to recognize the generosity of the state in this respect, being assured that under the wise and conservative management of Prof. Shaw the funds are to be so spent as to produce the greatest possible good to the greatest possible number of Michigan farmers.

There was a very visible increment to the funds of the experiment station arising from the passage of the Adams bill. During the year ending June 30, 1907, there came to the station from this source $7,000, which was spent upon the following five projects.

1. A study of the bacteriological factors influencing the keeping qualities of milk and butter.

2. A study of hog epidemics in Michigan.

These two projects were carried forward by the Bacteriological Department.

3. A study of the action of bacteria in rendering available the insoluble elements of the soil.

This project was carried forward by the Departments of Bacteriology and Chemistry, working jointly.

4. A study of the utilization of untreated rock phosphate.

This project was carried forward by the Chemical Division of the Experiment Station.

5. A study of the Grand Traverse disease of cattle.

This project was carried forward by the veterinarian and the director of the Experiment Station.

By the terms of the Adams bill the expenditure of this fund is limited to the prosecution of investigations and research aimed to the broadening of human knowledge on matters of pure science. At the same time the attempt was made in the selection of the topics named, to make the results of the investigations as immediately helpful as possible. No reports are forthcoming as yet or will be forthcoming in the immediate future in bulletin form from the expenditure of this fund. From the very nature of the work no definite results can be expected for some years to come.

It is pleasant to report, however, that in the matter of the Grand Traverse disease of cattle, definite and conspicuous progress has been made. Mr. A. R. Potts, for many years an employee of the station in the farm department, was sent to West Olive, where the disease was prevalent. An examination of the stomachs of the animals afflicted with the disease showed the third stomach to be in every case impacted. The adoption of a course of treatment aimed to relieve this condition resulted in the recovery of nearly every animal treated. The investigation as to the cause of the disease is still in progress.

There is attached to this report, and made part of it, the reports of the heads of the different divisions of the station work. These reports are full and hardly need comment from the director. I am glad to report that harmony has prevailed in the councils of the station, and that the investigations are progressing without waste of energy

in friction or in duplication. In view of this fact, it is somewhat unfortunate that the funds available for the publication of bulletins have been inadequate, rendering necessary the postponement of several bulletins until near the close of the fiscal year.

The work upon the station plots comes immediately under the supervision of the director. It is necessary by reason of the large number of people who visit the station during the summer, to carry forward some work which is spectacular rather than permanently useful. We have one series of plots called the curiosity strip, devoted to the growing of plants and crops that will be in their prime in August when the visitors arrive. It is the plan to place upon this series unusual crops or the newer things coming into Michigan agriculture like the varieties of soy beans, peppermint, peanuts, tobacco and some of the better types of the large forage plants, like pennisetum or kaffir corn. Without growing these crops into the larger plots, it now seems to be fairly well demonstrated that none of them can take the place of corn, where corn is possible. They may be used, however, to supplement corn when for some reason the latter crop is not available.

All other plots are used directly and entirely for the solution of questions of importance to the farmers. Professor Moses Craig has done very efficient service, which ought to be recognized in this report, in the matter of plant breeding. The first problem submitted to his skilled hand was the improvement of soy beans, or rather of a legume closely akin to the soy bean, called the Black Murarau. This legume was not breeding true to type. Mr. Craig made selections for two or more successive years, and has sharply differentiated the plant into two types, the one with a hastate leaf, the other with an ovoid leaf. The crop is a great yielder of seed and promises to displace the regular soys for seed production. The regular soys have also been carefully worked over, the hope being to train up some erect plants without too coarse stems, but with abundant foliage to be harvested as hay, while the same variety is trained to produce another type a little later with less leaves but with abundant seed, the stem also being slender rather than coarse. It takes time to accomplish results in this plant breeding, but I wish to acknowledge the efficient service of Mr. Craig in these two lines.

Alfalfa is undergoing selection, hoping to secure a strain which will seed abundantly in this latitude, and which will withstand the vicissitudes of the trying climate. The worse enemy of this useful crop is the June grass, which has practically crowded it out of the plots sown in 1903. In June, 1907, the crop is maintaining itself on the plots sown in 1905, the June grass not having made important invasions. The yields of alfalfa on all plots have been very satisfactory indeed, but if it is possible for the station to develop the seed production at the same time securing resistant qualities it will be of immense value to the state at large. To this end selected seeds have been planted to develop one plant in a place, the distance between plants being two feet in each direction. This will allow us to select the individual plants which have the greatest powers of endurance. The work with wheat has been continued, not alone with Dawson's golden chaff, but with other varieties, the plan being to determine the best plant, and then the best head in that plant, and with that as a start to produce strains which

will inherit the fecundity of the original head. The wheat thus developed, instead of being weaker and less able to stand the strain of a severe winter, seems to be stronger than the average crop of the same variety, these selected plots present a full stand and a vigorous growth.

The seed wheat yielded in July 1906 was distributed among the farmers at a low price per bushel, and is now widely scattered over the state, the buyers agreeing to reserve the yields this year for sale to their neighbors, providing the yields are satisfactory. This same method has been operated in past years until it is safe to say that nearly if not quite half of the wheat grown in the state comes from seed which at one time passed through the hands of the experiment station.

In the spring of 1907 the phase of the work known as plant breeding was developed. Mr. F. A. Spragg, a graduate of this college in the class of 1906, was chosen to carry forward this important line of experiments. He is devoting himself to the breeding of better strains of wheat, oats, soy beans, cowpeas, flax for seed, flax for fiber, corn, timothy and alfalfa. Through the courtesy of the farm department of the college all that part of field No. 7 lying south of a line drawn east and west ten rods north of the south line of the field, is devoted to this plant breeding, in addition to the plots in use in field No. 6 and in No. 3. Much attention is being given to white beans and to red kidneys. The presence of so much anthracnose in the state indicates the need for a more resistant strain.

It is unfortunate that this station is unable to develop the production of sugar beet seed satisfactorily. For reasons which do not seem easy of explanation, the per cent of sugar in the beets certainly though slowly decreases from the mother beets, as produced from the imported seed. The work has been carried forward for many years, and it seems fairly definitely decided that the soil conditions on the station farm are not adapted to the production of beet seed of such quality that it would be safe to recommend it for use to the factory.

The growing of peppermint is an important industry in certain parts of Michigan. During 1906-7 a study has been made of the diseases of that crop, and also of the methods of correcting them, expecting to publish a bulletin in the fall of 1907 setting forth not only the history of the crop in the state, but the method of producing it as well as the enemies which afflict it with suggested remedies.

So much attention has been attracted to the question of corn growing that during the season of 1906 several large plots were devoted to a study of the fundamentals of the matter. The question was asked the plots whether the appearance of the ear had aught to do with its value as seed corn, supposing that the chief value of any seed lay in its ability to produce a large yield. 120 ears were used in this test. The details are reserved for publication later, the general result being that the quality of productivity did not manifest itself in the outward appearance of the ear farther than is included in the statement that a bright, clean ear has greater germination and greater vigor than a tall and somewhat moldy one. The shape of the ear, as to the tip and butt, seemed to have no relation to its productivity. The station felt justified therefore in taking the stand that the best, and perhaps the only successful way to select seed corn, was to plant one ear to the row for one year, and then select for seed the production of the ear giving

the largest yield. This matter will be worked over and over for several years to come until it is safe to make definite pronouncements.

The fact that the fiftieth birthday of the college occurred on the 13th of May, made it wise for the experiment station to prepare and present for publication a bulletin giving the history of experimentation at this institution from the day of its foundation to the present. Such a history has been begun under the direct supervision and planning of the director by Professor J. D. Towar. The reports of the Upper Peninsula and South Haven sub-stations are attached to and made a part of this report.

Through the co-operation of some thirty farmers in different parts of the state, the station is giving the farmers the benefit of its selections of corn, oats and wheat. The results of this work will be published briefly later, although the benefit accrued not through the publication, but through the actual use of the seed grains sent out.

C. D. SMITH,
Director.

Agricultural College, Michigan, June 30, 1907.

REPORT OF BACTERIOLOGIST.

To Director C. D. Smith:

For some years it has been the policy of this laboratory to strive towards more technical investigations, believing that the interests of agriculture would be best subserved by so doing; at the same time the necessity for ready results to meet the demands of the farmer has not been disregarded. The results of this policy are only manifest to the outsider by the bulletins issued.

Changes are taking place and among these changes, it seems to me I am able to note a disposition on the part of the agricultural educator and experimenter to play the role of populariser and interpreter of scientific results and scientists, although he does it many times to his own detriment and that of the scientist. To my mind there are good features in this, and, in many instances, this method would be desirable not only to the scientist, who prefers to talk in his own language, but also for the scientific-practical-agricultural educator or experimenter. To be a good scientist too much time cannot be spent in dissipation along lines remote to his work; to be a good scientific-practical-agricultural educator or experimenter too much time cannot be given to the technique of a scientist, but let both work to the advantage of each other and consequently to the advantage of the farmer.

If the above view is correct, it follows that the scientist, so far as investigations are concerned, can best give his time to the discovery of new truths or facts or to the study of old truths or facts in new relationships or settings.

Truth, as considered by man, is never absolute, but relative. To explain more fully, the truth of today may be an untruth of tomorrow. This is doubtless on account of man's limitations of vision. He can see but one setting for what to him is a truth. Persisting in

this course, man soon becomes obsolete or a fossil, in other words, he has closed his mind to progress or change. Inasmuch as all of our ideas, notions, decisions or conclusions are based upon only relative conditions, it follows that there is no such thing as absolute fact for man. This is borne out by the many new interpretations of old truths —few are what they were a few years ago. Their aspects have been changed, hence to the human mind, they are not what they were—all because a new setting or new conditions have environed them.

Because of this relation of truths to environmental conditions and the absence of absolutism, the possibilities of relational studies are limitless. Each new relational interpretation adds materially to the fund of available human knowledge.

In this light, the work of this laboratory proceeds, ever striving for new truths, or for old truths in new relationships. We are writing only occasional popular bulletins, because we believe such work can be better accomplished elsewhere. Only when the nature of the subject demands our services, shall we undertake such duties, unless it is otherwise requested.

Our energies, therefore, are devoted to technical research. Of course, our problems are strictly agricultural problems, as the appended list will indicate:

Factors which influence the keeping qualities of

a. Milk.

b. Butter.

Studies of swine epidemics in Michigan.

Micro-organisms as instrumental agents in rendering the insoluble constitutents of the soil available to plants.

In the investigation of problems so intricate, patience should be exercised not only in the work itself, but also by those who await results, for the investigators concerned wish to be as nearly right as conforms with the powers of man.

From time to time technical publications may be issued, the outgrowth of these main lines of study, which will contribute, directly or indirectly, to agricultural science.

Very respectfully submitted,

CHARLES E. MARSHALL,

Bacteriologist and Hygienist.

Agricultural College, Michigan, June 30, 1907.

REPORT OF THE HORTICULTURIST.

To the Director:

Sir—The work that has fallen to me during the year now closing has related largely to co-operative experiments along horticultural lines, although the general charge of the South Haven station and the correspondence that has reached me have taken a considerable portion of my time.

CO-OPERATIVE EXPERIMENTS.

This class of work has been found desirable for two reasons; first, the conditions both at the college and at South Haven make it impossible to carry on experiments in spraying, orchard tillage, fertilizing, etc., for which considerable areas are necessary, and second, it has been found that if the work is carried on in a section where the results can be noted by commercial growers, they are far more likely to be accepted as conclusive than when they are given out in bulletins.

Spraying for San Jose Scale.

Various phases have received attention. The most attention has been given to the testing of remedies for the control of the San Jose scale, including the various proprietary compounds on the market. After using it for four years we are more than ever convinced that fruit growers will find in the sulphur-lime mixture a remedy which, although it has its objectionable features, is reasonably satisfactory so far as efficiency, safety, cheapness and ease of preparation and application are concerned.

The use of twelve to fifteen pounds of either flour or flowers of sulphur and twenty or twenty-five pounds of lime is recommended for fifty gallons. The lime and sulphur should be boiled for one hour in fifteen or twenty gallons of water in order to produce a chemical union of the two materials which will enter into solution. It can then be diluted, either with hot or cold water, but it should be at least warm when applied. While equal weights of lime and sulphur are recommended by many persons, we do not think it advisable to make any change in our original formula as given above, as the excess of lime gives the trees a white appearance, which is very helpful in determining the thoroughness of the application, without which good results cannot be expected.

When properly prepared the lime-sulphur mixture can be used with safety upon all deciduous trees and shrubs, while in a dormant condition, but it will injure the foliage and should not be used after the leaves have opened, except in cases where the trees are found to be badly infested during the summer. As they may be ruined before autumn, it may then be well to spray the trees, endeavoring to cover the trunks and larger branches without allowing very much to reach the leaves. In this way any serious results to the trees can be prevented as, although the ends of the branches may be killed, they can be headed back and a new top grown.

The best time for spraying to control this insect is as late as possible in the spring, and the work can be continued up to the day the blossoms burst open. Spraying during the winter months is not advisable in the northern states, but fairly good results can be obtained when the trees are sprayed as soon as the leaves drop in the autumn.

While an ordinary jacketed kettle holding forty or fifty gallons can be used for cooking the mixture, a steam boiler will be found more satisfactory for large orchards, especially as it permits of elevating the tank or barrels in which the cooking is done to such a height as will allow the mixture to be drawn off into the spraying tank. Dipping,

which is one of the leading objections to the use of the lime-sulphur remedy will thus be avoided.

Whatever remedy is used, it cannot be effectual unless the work is thoroughly done as, if any of the infested portions are left untouched, a sufficient number of the scales will be left alive to quickly reinfest the trees.

The results with the lime-sulphur mixtures were very satisfactory, and one thorough spraying in April was sufficient to greatly reduce the number of the scales. The treatment also has a very beneficial effect in other ways, as it loosens the rough bark and lichens and gives the bark a smooth healthy appearance, besides lessening the injury of fungi on the leaves and fruit.

None of the so-called soluble oils, not any of the prepared sulphur-lime pastes, proved effectual in preventing the spread of the scales. Even when used at double strength there were two or three times as many in the fall as before they were sprayed in the spring, and at this rate of increase the trees would soon be killed.

Trouble was experienced in securing a stable emulsion of the oils with hard water, and in addition to this there is the danger of injuring the trees with the uncombined oils. Reports from a large number of persons who used the oils in 1906 were received, and with few exceptions they were unfavorable. In one or two cases where the oils were said to have held the scale in check, the trees were found on examination to be badly infested.

Grape Rot and Mildew.

During the past two years reports of injury to the vineyards in Southwestern Michigan from the black rot and mildew of the grape have lead to co-operative experiments at several points in that section. The injury from these diseases has not become general, as it is for the most part confined to the vineyards in the southwestern counties and even there only a portion have suffered material losses.

The black rot has been especially troublesome on north slopes and in hollows where the circulation of air is poor, and the vines do not dry off quickly. Under these conditions the crop was ruined in many cases, while in the neighboring vineyards little harm was done. The downy mildew also did much injury in similar locations, and in vineyards that were neglected. This disease not only destroyed much of the fruit, but by attacking the leaves, the ripening of the fruit was delayed, and in severe case prevented altogether.

It has been known for some years that these diseases can be controlled by spraying the vines with Bordeaux mixture, and arrangements were made with several prominent grape growers for co-operative experiments. The objects were two-fold: to ascertain how many applications can be made with profit, and the dates for making them. It is too early to give any definite conclusions, especially as at best the practice will need to vary with the location, season, varieties and the conditions of the vineyards, but in all cases where either of these diseases has appeared, and very few vineyards are entirely free from the downy mildew, it seems advisable to spray with a solution of copper sulphate (two pounds in fifty gallons of water) just before the buds

swell. An application of Bordeaux mixture should be made when the blossom buds are ready to open, and it should be repeated when the fruit is of the size of a pea. In case the diseases have been troublesome in previous years, and especially if the weather during July and August is wet and muggy, this can be continued with good results every ten days up to within three weeks of the ripening of the crop. For the first application it will be well to use four pounds of copper sulphate and five pounds of lime in fifty gallons of water, but this can soon be reduced to three and four pounds respectively, and for the last spraying, if made after the middle of August, use only two pounds of copper sulphate and the same of lime in fifty gallons of water. In cases where the rot is very troublesome late in the season, it is often advisable to use soda Bordeaux, which will not spot the fruit.

POTATO BLIGHT.

During the summer of 1905 the conditions were quite favorable for the development of the blight and rot of the potato, and serious loss resulted. It had been conclusively shown by experiments carried on at this and other stations that this disease also could be held in check by thorough spraying with Bordeaux mixture, and in 1906, although the disease was less prevalent than in the previous year, it was practiced with good results in many sections.

The rot and blight are caused by a fungus which develops rapidly under the same conditions as are favorable to the rot of the grape. It seldom does much harm to potatoes that ripen before August first, but the later varities, particularly if on low and wet land, are sometimes entirely destroyed if the weather in August is muggy. Bordeaux mixture is also a specific for the early blight which comes in June and July, and if it becomes necessary to spray for the potato beetle, the addition of Paris green will be helpful. For the late or true blight the spraying need not begin until the latter part of July or early August. One application can always be made to advantage, and this should be followed at intervals of ten days with two or three others, if the weather is favorable to the development of the blight. In seasons when unsprayed vines are entirely destroyed, it is possible to carry a crop through with little or no loss if the vines are kept covered with the spray. As it is only valuable as a preventive, it is desirable that one application be made before the season comes for the appearance of the disease, but if the weather during August is dry, the periods between the sprayings can be extended, but whenever blight appears, or the weather becomes favorable for the development of blight, the vines should receive an application.

That spraying for blight is a safe investment, even as an insurance, it should be noted that it only costs about one dollar to spray an acre of potatoes, and that as the crop is often entirely destroyed when attacked by blight, four or five applications will result in saving several times their cost.

ORCHARD SPRAYING.

The growers of first class fruits are of the opinion that to secure the best results it is necessary to thoroughly spray the trees with a fungicide. For this purpose Bordeaux mixture is generally used. Some varieties require more attention than others, but one or two applications can always be made to advantage, and in the case of certain varieties from five to seven treatments will be found very profitable in seasons favorable to the development of fungi.

The benefit is not alone in the improvement in the appearance of the fruit, owing to its freedom from blemishes due to work of insects and diseases, but one or two applications early in the season will often result in preventing the loss of the crop. If the weather is cold and wet at the time the trees blossom, fungi not infrequently attack and destroy the blossoms or young fruits. Many cases are known where large crops have been secured from orchards that have always been unfruitful, and the fruit has sold at from two to three dollars per barrel, while that from the average unsprayed orchard has not been worth gathering.

Much injury has been done in recent years to the apple crop by the coddling moth, even when the trees have been sprayed, but the failures have been due to a lack of thoroughness or to limiting the spraying to a single application just after the blossoms have fallen. The greatest injury has been done by the second brood, which appears about the middle of August, and which will not be affected by a spraying given in June. While one application about the first of August might answer, the best results have been secured by spraying during the last week in July and again two weeks later.

For many years we have advised spraying apple, and, in fact, all fruit trees as soon as the fruit has set, and repeating the application upon everything except the peach, in twelve to fifteen days. Although this advise was based upon actual experience, many have contended that there was no benefit from spraying apple trees for the codling moth after the calyx lobes had closed and the fruits turned down. During the last year or two experiments in several states have demonstrated the wisdom of the advice we have repeatedly given, so far as the codling moth is concerned, and especially when fungi are troublesome, the use of Bordeaux mixture is so desirable for their control that spraying with a combined fungicide and insecticide at intervals during the season, from the middle of May to the middle of August, cannot be too strongly recommended.

ARSENITES AND THEIR USE.

Paris green has been most generally used for the destruction of leaf-eating insects, but it is difficult to keep in suspension, and it does not adhere well and besides it is not only likely to injure the foliage, but the price has nearly trebled in the last ten years. For twelve years we have been making use of white arsenic as a substitute. This costs but one-fourth as much per pound, while it contains double the amount of arsenious oxide. Arsenic is slightly soluble in water and will burn the foliage unless united with some base with which it will form a stable compound. The cheapest is quick-lime, and one merely needs to boil

five pounds of arsenic with ten pounds of freshly slacked lime in ten gallons of water for forty minutes to obtain the equivalent of ten pounds of Paris green. The arsenite of lime thus formed is in the form of a rather coarse, granular precipitate, which should be pulverized or rubbed through a fine seive before it is added to the spraying mixture. If used with Bordeaux mixture, it will be well to add a slight excess of lime, and two or three pounds of lime should be added to fifty gallons, if to be used in water. Five pounds of arsenic prepared as above will be sufficient for 500 to 1,000 gallons, according to the number, kind and age of the insects to be treated.

Although about twice as expensive, and exactly the same in the end, some fruit growers prefer to dissolve the arsenic in an alkali. This can be readily done by boiling five pounds of arsenic and ten pounds of washing soda in five gallons of water. The clear solution thus formed should be added either to Bordeaux mixture or lime water as directed above, using one quart to 50 or 100 gallons.

The best insecticide for this class of insecticide is arsenate of lead. This is manufactured by several firms and sold under various proprietary names, of which "Disparene" is best known. It contains only twelve to sixteen per cent of arsenious oxide, and hence to equal Paris green three or four times as much should be used. At the present prices it costs but little more, and it has the merit of being safe to use upon all plants, while its adhesive properties are much greater than those of either Paris green or arsenite of lime. The best results against moist insects are obtained when used at the rate of two to three pounds in fifty gallons of waters, but for June bug and rose chafer, as much as five pounds in fifty gallons will be necessary.

ORCHARD TILLAGE.

Although the larger commercial orchards have more attention, the apple orchard on the average Michigan farm is allowed to grow in sod with little or no care. During the year arrangements have been made with farmers in various parts of the state to test different methods of handling their orchards. One section is left in sod without further attention, another is cultivated early in the season and sowed to oats, or some other cover crop, and other portions are mulched with straw, or other refuse, so as to prevent the growth of grass over a circle considerably larger than the spread of the branches. The mulched sections, especially when a liberal amount of manure forms a part of the mulch compare favorably with those that are cultivated, and in many parts of the state straw is so readily obtained that it is cheaper than to cultivate.

FERTILIZER EXPERIMENTS.

Although stable manure, supplemented by wood ashes, would answer every purpose as an orchard fertilizer, it is not readily obtained, especially in the sections of the state where fruit growing is the leading industry, and orchardists are finding that something else must be obtained. Our experiments in this line are with apples, peaches and grapes of the fruits and also with the potato. Various mixtures of acid phosphate,

muriate and sulphate of potash and nitrate of soda are being tested. While it is not likely that the use of any of the materials will prove desirable under all conditions, it is probable that to supplement stable manure and clover, some form of phosphate and possibly also of potash can generally be applied with profit.

THE SOUTH HAVEN STATION.

Mr. Frank A. Wilken has continued in charge of the work at South Haven and has also had the oversight of the cooperative spraying, tillage and fertilizer experiments in that section, all of which duties he has performed in a highly satisfactory manner.

In the past most of the land at the South Haven station has been used for variety tests of fruits, but the removal of some of the older peach trees and a portion of the grapes which have served the purpose for which they were planted, has afforded room for undertaking a number of tillage experiments and, later on, they can be used for spraying and fertilizer work.

The orchards are in a satisfactory condition except the peaches and Japan plums which suffered seriously from the effects of the freeze of October 10, 1906. Some injury was also done to the grapes and nearly all of the raspberries and blackberries were killed to the ground.

While the present sub-station should be continued for a number of years, there is need for more land in order that many experiments for which plans have been made may be carried out. It is not possible with only twelve acres of available land, most of which is planted for variety testing, using only two trees of a kind, to carry on the work that is being called for by the fruit growers of Michigan. If a tract of forty acres convenient to South Haven could be obtained for the purpose, the results would be materially increased with but a slight increase in the expense of maintenance.

EXHIBITS AT FAIRS.

As in past years extended exhibits were made at the state fair at Detroit and at the West Michigan Fair at Grand Rapids. In addition to the use of collections of varieties of fruits, an endeavor was made to show the results of the experimental work in the way of spraying.

Respectfully submitted,

L. R. TAFT,
Horticulturist.

Agricultural College, Mich., June 30, 1907.

REPORT OF ASSOCIATE HORTICULTURIST.

Director C. D. Smith:

Sir:—I submit my second annual report as associate horticulturist of the Michigan Agricultural Experiment Station, in charge of the experimental work in horticulture at the college. The general policy of this division is stated in my last report as follows: "I suggest that the dominating features of experimental work in horticulture at the college be two: Cross-pollination and plant breeding. This does not mean that other needed lines of investigation shall be neglected but that our energies shall be expended mainly upon these two subjects."

EXPERIMENTS IN PROGRESS.

These may be classified as follows:

Pollination Expirements.

1. Cross-pollination of orchard fruits.
2. Cross-pollination of the strawberry.
3. Cross-pollination of forced tomatoes.

Plant Breeding Experiments.

4. Selection of seed potatoes.
5. Breeding blight-resistant varieties of potatoes.
6. Strawberry breeding.
7. Breeding orchard fruits.
8. A study of the varieties and unnamed seedlings of Michigan origin.

Miscellaneous Experiments.

9. Spraying for potato blight.
10. The control of the diseases of greenhouse lettuce.
11. Cold storage of fruits.

1. *Orchard Pollination.* This work has been conducted for several years. The main practical objects are to determine which of the common commercial varieties of fruits are benefited by being planted near other sorts for the purpose of cross-pollination; and what varieties it is best to plant together. Incidentally the relation of rainy weather, frost, and spraying in bloom to the setting of fruit will be investigated. The results of the work with Bartlett and Kieffer pears are now being prepared for a bulletin. About 10,000 fruit blossoms were under experiment the past spring. Our design is to ultimately have a greenhouse devoted exclusively to the forcing of dwarf fruit trees in pots, for the purpose of studying these important problems in a climate that we

ourselves can control absolutely, rather than in the uncertain climate of a Michigan spring.

2. *Cross-pollination of the Strawberry.* The objects of this work are similiar to those in orchard pollination. The experiments were begun on forced strawberries in the college greenhouses during the winter of 1905-6. They were continued in the field in the spring of 1906, and again on forced plants last winter. We shall need to work at this several more seasons. A field experiment, embodying the results of the experiments in the greenhouse, is now under way.

3. *Cross-pollination of forced tomatoes.* The objects of this investigation are to determine if varieties of tomatoes are benefited by cross-pollination; and also to determine how much influence the amount of pollen applied to the stigma has on the size and regularity of the fruit. A bulletin embodying the results of two winters' work is now in your hands. The work will be continued by Mr. Gregg.

4. *Selection of seed potatoes.*. The object of this experiment is to determine the practical value of selecting seed potatoes only from the most desirable hills. A selection of hills was made from an acre of Rural New Yorkers last fall, on the basis of size, form, number and weight of tuber in hill. A similar selection will be made from the plants now growing from these selected tubers. This work should continue several years before a report is made.

5. *Breeding blight-resistant varieties of potatoes.*. We seek to do this in two ways:

(a) By selection. Over 100 varieties, including all those that have shown marked blight-resistant qualities, are being grown. They have been secured from all over the country, and some have come from Japan. Only the best hills are saved. A very marked difference in blight resistance is noticed.

(b) By crossing and raising seedlings. We have not yet been successful in crossing, owing to the few and imperfect blossoms that are borne on potatoes grown here. In 1906 and 1907, 8,000 potato seedlings, from seed obtained from Colorado have been grown, and a minute record and description made of each. Some of these seedlings are decidedly promising. The most blight resistant have been saved and will be used for further selection.

6. *Strawberry breeding.* The practical aspect of this investigation is to secure improved varieties of strawberries especially a productive, very late variety, which would be a blessing to Michigan growers of the unproductive Gandy; and to determine how much of practical value there is in "pedigree" strawberries, or the selection of especially good plants from which to take runners, in comparison with the common nursery method of propagating from all plants at random. A minute record has been kept of the behavior of each individual plant in a field of 8,000 plants, of five varieties, set in the spring of 1906 for this purpose; including the vigor, number of runners thrown out, number of fruit stalks, total number of blossoms, number of blossoms killed by frost, dates of ripening, number and weight of fruits borne by each plant, and other features. Selection has been made for each variety as follows:

(a) The fifty most productive plants.

(b) The fifty least productive plants of equal vigor as the preceding.

(c) The fifty plants ripening their fruits earliest.

(d) The fifty plants ripening their fruits latest.

10 to 30 runners have been taken from each selected plant. These will make the new field, on which a similar selection will be carried out. The work should continue for at least five generations of plants.

A second phaze of the work in strawberry breeding is the origination of new varieties by crossing. We now have about 10,000 seedling strawberries, most of which will fruit for the first time in 1909. A few will fruit in 1908. The crosses have not been made in a hap-hazzard way, but with a definite ideal and plan; as a cross of Marshall and Dunlap, to secure a Dunlap of better quality and a cross of Gandy and Brandywine to secure a more prolific Gandy. The main point that we are breeding for is lateness.

7. *Breeding orchard fruits.* This work is incidental and supplementary to the work in orchard pollination. The seeds of the fruits resulting from the experiments in cross-pollination are saved and planted. We now have 500 young seeding pears, the results of crossing Bartlett and Kieffer with each other, and with Anjou and Lawrence. The hope is that some of these seedlings may develope into a blight-resistant variety of better quality than Kieffer. Spy seedlings are also being grown. In all the work we have a definite ideal in view and keep full records of all the progeny.

8. *Varieties of Michigan origin.* Data is being collected concerning varieties and promising seedlings that are of Michigan origin in the belief that, to a large extent, the most valuable varieties of the future will be local varieties. Full pomological descriptions are made, photographs are taken, with notes on the origin, and present horticultural value of the varieties.

9. *Spraying for potato blight.* This experiment has been continued as outlined in the preceding report. It is incidental to work in potato breeding for blight resistance.

10. *Diseases of greenhouse lettuce.* The experiment in sub-watering and sterilizing greenhouse soil, by means of lines of agricultural drain tile laid 18 inches below the surface and 24 inches apart, has been continued in the greenhouse of F. M. Strong of Grand Rapids. This experiment is being watched by the lettuce growers of Grand Rapids, some of whom are convinced that the method we have adopted may be developed into a practical means of controlling the diseases that frequently ruin the lettuce crop. This experiment had its origin in an attempt to control the "Shot-hole Rust" (Marsonia perforans) but has been extended to meet other conditions. The work has also been conducted in the college forcing house. We should be able to report next spring, at the conclusion of the third seasons' work.

11. *Cold storage of fruit.* For two years we have conducted an experiment in the cold storage, to determine the relative importance of various factors that influence the keeping qualities of apples and pears, such as the presence of scab, worms, bruises, the degree of maturity, condition of tree, etc. The work will be continued and extended this year and a report made next spring.

THE ORCHARDS AND GARDENS.

The balance of the south block of apple trees was thinned out this year, leaving the trees two rods apart. About fifty trees, varieties that had proved to be valueless here, have been top worked to standard sorts, like Baldwin, Spitzenburg, etc., of which we now have very few on the college grounds. Part of the middle block of apples will be thinned likewise the coming winter. Many worthless varieties have been cut out of the variety pear orchard and the orchard has been seeded to clover for three years to check blight. A small commercial plum and quince orchard has been planted and the sour cherry orchard extended. Commercial plantings of raspberries and blackberries have been made, for breeding experiments. We propose to plant a commercial vineyard of one and one-half acres next spring and a commercial pear orchard of three acres. These commercial plantings are of but one to three standard varieties, so that they may be used for experimental purposes. No experiments with vegetables are now under way, except the potato breeding work already noted.

Respectfully submitted,
S. W. FLETCHER,
Associate Horticulturist.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE ENTOMOLOGIST.

Prof. C. D. Smith:

Following is a brief report of the work of the division of entomology during the year ending June 30, 1907.

On bulletin has been issued during the year, viz.: No. 244 being accounts of a number of insects which were new or little known in Michigan, also of some that were of especial interest just at that time.

Two very serious pests are at present doing injury in our state, one the Imported Larch Saw-fly (*Lygaeonematus erichsonii*) which is killing off large tracts of tamarack in the northern half of the state, and the other, the Mediterranean Flour-moth (*Ephestia kuhniella*). This latter pest is a small delicate creature which probably came from Europe. It has appeared in many of the several states in the United States and has now become firmly established in Michigan. It works in flouring mills, spinning webs throughout troughs, elevators and elsewhere, clogging the machinery and binding the flour into felted masses. Fumigation has been the standard remedy in other places and no doubt we shall be obliged to resort to it here.

A number of trips have been made to investigate various invasions of insects, one to Petoskey and vicinity to look up the larch saw-fly, one to Paw Paw to look after a beetle (*Anomala binotata*) that was feeding on young apple trees. A trip was also made to Benton Harbor to address the Berrien County Horticultural Society and one to Bancroft to address a farmers institute.

Several trips have been made to look into reported invasions of the

gypsy moth and of the brown tail. While these insects have not as yet been found in our state, they may appear at any time. When they do arrive our only salvation will depend on prompt and decisive measures. For this reason it has been deemed worth while to investigate many reported invasions, thinking it better to follow up many false trails than to allow one real colony to remain undiscovered.

The correspondence has continued to occupy considerable time. Determinations of a large number of specimens sent in have been made for the farmers whose crops have been threatened or whose fears have been aroused. A large series of scale insects (*Lecanium*) have been collected and mounted on slides ready for study, by Mr. E. J. Kraus who has rendered very valuable assistance in this and in many other ways.

We have now in pure culture two fungi which are parasitic on insects, one was isolated from a specimen of *Lagoa crispata*, one of the flannel moths, and the other from the larch saw-fly. While work with disease producing fungi is usually disappointing, it sometimes throws light on insect behavior and is one of the possibilities for controlling certain forest species which may not be sprayed because of the enormous expense which would be incident to such methods.

Life history work, namely the rearing of insects to ascertain the stages and the dates of transformation, etc., has been carried on as well as possible in the absence of an insectary and in our one room. It is hoped that it will be possible to have an insectary at no distant time when such work may be done successfully.

Very respectfully submitted,
R. H. PETTIT,
Entomologist.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE VETERINARIAN.

Director C. D. Smith:

Dear Sir:—As consulting veterinarian for the experiment station I have during the past year answered a large number of inquiries from farmers relative to diseased animals. The only serious contagious disease has been the contagious swine disorders. A great many hogs were lost. Judging from inquiries received more than for some years past.

The feeding experiments planned last fall with reference to the so-called "Lake Shore" disease were carried out at West Olive by Mr. A. R. Potts. The results were very satisfactory and seemed to indicate that the diseased condition was the result of poor feeding. We are not in position as yet, however, to make definite statements, but would suggest that the work be continued along the same line for another year with special reference to the feeding of some succulent food during the summer months when the pastures are poor and what feed there is is dry.

Respectfully submitted,
GEO. A. WATERMAN,
Consulting Veterinarian.

Agricultural College, Mich., June 30, 1907.

REPORT OF LIVE STOCK EXPERIMENTATION.

Director C. D. Smith, College:

Dear Sir:—During the fiscal year ending June 30th, 1907, the following bulletins relating to live stock investigation were issued from the farm department, viz.: No. 240, entitled "Roots Supplimentary to Silage for Dairy Cows;" 241, "A Plan for the Improvement of Michigan Cattle"; 242, "Feeding Whole Grain;" 243, Cull Beans as a Food for Swine;" 245, "Poultry Raising, and 247 Beet Pulp for Fattening Cattle." The data upon which these publications are based was secured through the expenditure of Experiment Station, Special Live Stock and Farm Department Appropriations.

Throughout this year the investigations relating to the *grade dairy herd* was continued. In this work two objects are being sought, first, to determine what good feeding, care and management will do to increase the productiveness and profits from these common cattle over and above the average returns received throughout the state, and second, to see what results can be secured through a system of up-grading, or the continuous use of the same pure blood on each succeeding generation. The first annual report of the results from this herd was issued as bulletin No. 338, dated May, 1906. The results of the second years work is complete and the third year is in progress; it is the intention to issue the results of these two years work together.

The first years results from the *grade beef herd* are complete, and the animals of this group are well along in the second year. The object in this case is to determine the cost of beef production by two methods, viz.: In the first group there are ten cows whose calves suckle them throughout the entire period of lactation receiving the necessary supplementary food in addition. The cost of these young beeves at 1000 lbs. weight is determined by charging against them all the food consumed plus the food and keep of the dams for twelve months following the birth date. On the other hand the ten cows are milked, and after the removal of the fat from the whole milk the skim milk is fed to the calves along with supplementary food. A record is made of the cost of keep of the cow for the year and her account is credited with the butterfat produced. The cost of producing the skim milk calf is recorded until it attains a weight of 1000 lbs. According to the original plans this work is not to be reported on until the end of the third year, in order to secure general averages that will be reliable.

For the past three years individual records of the cost of producing calves from birth to twelve months of age have been secured until about fifty are now on file. These records include calves of both beef and dairy classes. It is intended to report the methods employed and results secured as soon as the work with the present group under experiment is complete.

During the past two or three years facilities for carrying on experimental work with sheep were lacking, but with the addition made to the sheep barn this year it became possible to again take up the work. The experiment now in progress consists of a test to determine the

effect of a succulent factor (roots) in the ration on (1) quality and quantity in wool production, (2) size and vigor of lambs at birth, (3) ability to produce milk and (4) effect on quantity and quality of meat produced. Thus far sixty breeding ewes and forty lambs have been used in the experiment; the first of the series of three tests in this experiment is complete.

I regret to report that the experimental work with swine was stopped entirely by an epidemic of swine disease which broke out about the first of the present calendar year and continued for about two months. The first of a series of experiments was in progress to determine the relative cost of production with extreme bacon, lard and intermediate types of hogs. The Poland China was chosen to represent the lard type, and Tamworths and Yorkshires the bacon type. The intermediate sorts were produced by using Poland China, Duroc Jersey and Berkshire boars on Tamworth and Yorkshire sows. As these crosses cannot be bought in the market but must be produced here, this work cannot be put under way again before the spring of 1908. Large numbers of pigs of the various types were being used in the tests which are to run throughout three series.

In three different localities in the state at private farms, work was undertaken to determine the efficiency of dried beet pulp as a supplement to failing pastures for dairy cows. Further work along this line seems necessary before reporting. One great obstacle in the way of carrying out this work resulted from the lack of available wagon or stock scales in farming communities.

Respectfully submitted,

R. S. SHAW,

Experimenter with Live Stock.

Agricultural College, Mich., June 30, 1907.

REPORT OF THE CHEMIST OF EXPERIMENT STATION.

Director C. D. Smith, College:

I submit herewith a brief report of the work of the chemical department for the year ending June 30th, 1907.

The work of the department is divided naturally into two kinds, namely, investigational and routine analytical. The greater part of the time of the department is taken up with the latter and must necessarily be so under the present conditions for several reasons. Our laboratory facilities are inadequate to accommodate more than two chemists working at the same time and then, only when they are doing work of a similar nature. A considerable number of samples of feeding stuffs, fertilizers, sugar beets, soils, etc., are sent in for analysis and when it is possible to comply with the request it is always done. We have also been called upon to do more or less work for the other departments. All this consumes a large portion of our time, and, though it is legitimate and necessary work it reflects but little credit, publically, to this department, and consequently leaves but small opportunity for investigational work.

FERTILIZER CONTROL.

The work connected with the enforcement of the fertilizer law has been steadily increasing and it has now become necessary to employ another assistant while this work is in progress, and it also means that all other work must be dropped, investigational work must be abandoned from the first of April until the middle of August.

During the past season five new fertilizer companies have entered the field, selling from one to five different brands each, and many of the old companies doing business in the state have put new brands upon the market.

The fall shipment of fertilizers into the state is beginning to assume considerable proportions and, as many brands are not put on the market in the spring it seems desirable that, in the future, a fall collection be made.

It is very gratifying to note the increasing use, by the farmers, of the fertilizer bulletin as a guide in making their purchases.

During the past year, an investigation was undertaken with leguminous crops to determine the relative amounts of nitrogen taken from the air and soil during their growth. The results obtained, however, did not warrant publication and this investigation will be repeated.

The investigation undertaken two years ago in conjunction with the bacteriological department on the solvent action of bacteria upon certain insoluble phosphates has been continued and a preliminary report is now ready for publication. In connection with this investigation an experiment was initiated this spring upon the Howard Farm at Edwardsburg, Mich., where the soil conditions are especially favorable for a practical application of the results of our laboratory investigations. The field experiment will be carried on for at least five years.

Miss Dorothea Moxness has continued the efficient assistant in this department and in closing this report I wish to acknowledge my personal indebtedness to her.

Respectfully submitted,
ANDREW J. PATTEN,
Chemist.

Agricultural College, Mich., June 30, 1907.

METEOROLOGICAL TABLES.

16

METEOROLOGICAL OBSERVATIONS.

Meteorological observations for the month of January, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	20	24	29.27	29.35	32	17	Clear	s w	0.0	0.0	1
2	25	34	29.27	29.09	36	20	Pt. cloudy	s e	0.0	0.0	2
3	33	40	28.74	28.08	46	29	Cloudy	s	0.45	0.0	3
4	29	29	28.23	28.45	30	11	Cloudy	w	0.05	0.50	4
5	27	30	28.57	29.53	39	21	Cloudy	s w	0.0	0.0	5
6	23	25	28.79	28.93	29	23	Clear	w	0.0	0.0	6
7	22	14	29.15	29.21	23	13	Pt. cloudy	w	0.0	0.0	7
8	12	13	29.25	29.22	19	11	Pt. cloudy	w	0.0	0.0	8
9	15	18	29.17	29.11	20	10	Clear	s w	0.0	0.0	9
10	21	29	29.05	29.14	36	15	Clear	s	0.0	0.0	10
11	28	25	29.14	29.10	40	25	Cloudy	s	0.0	0.0	11
12	30	31	29.25	29.29	39	30	Clear	n w	0.0	0.0	12
13	28	33	29.10	28.91	35	27	Cloudy	e	0.04	0.0	13
14	34	36	28.83	28.86	36	32	Cloudy	s w	0.19	0.0	14
15	38	41	28.70	28.23	49	35	Cloudy	s	trace	trace	15
16	33	26	28.37	28.74	34	33	Cloudy	w	0.07	1.00	16
17	22	25	28.91	28.61	37	23	Cloudy	s	0.05	0.60	17
18	33	29	28.47	28.87	34	25	Cloudy	w	0.03	0.30	18
19	27	31	29.05	28.76	32	25	Cloudy	e	0.0	0.0	19
20	42	56	28.60	28.65	62	33	Cloudy	s	0.0	0.0	20
21	55	56	28.77	28.75	60	54	Cloudy	s	0.0	0.0	21
22	40	32	28.69	28.65	40	40	Cloudy	n	0.0	0.0	22
23	33	28	28.76	29.18	34	32	Pt. cloudy	w	1.10	0.0	23
24	23	23	29.40	29.55	29	21	Cloudy	n	0.0	0.0	24
25	25	30	29.55	29.49	35	22	Pt. cloudy	s e	0.0	0.0	25
26	23	34	29.46	29.29	44	22	Clear	s	0.0	0.0	26
27	28	37	29.14	29.02	43	28	Pt. cloudy	s	0.0	0.0	27
28	33	34	28.99	29.04	43	30	Pt. cloudy	n w	0.0	0.0	28
29	28	40	29.03	28.79	41	28	Clear	s	0.0	0.0	29
30	26	34	28.78	28.89	38	35	Cloudy	w	0.0	0.0	30
31	20	28	29.17	28.94	29	20	Pt. cloudy	w	0.0	0.0	31
Sum	876	965	897.66	897.77	11.35	810			1.99	2.40	
Average	28.2	31.1	28.95	28.96	36.6	26.1					

Meteorological observations for the month of February, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall inches.	
1	26	7	28.76	29.19	30	6	Cloudy	n w	0.15	1.50	1
2	-1	9	29.31	29.33	20	-4	Pt. cloudy	s w	0.0	0.0	2
3	9	18	29.13	28.84	27	-8	Cloudy	w	0.0	0.0	3
4	25	8	29.29	29.31	35	-10	Cloudy	n e	0.0	trace	4
5	-3	0	29.48	29.55	10	-3	Pt. cloudy	n	0.0	0.0	5
6	-5	9	29.55	29.48	11	-6	Pt. cloudy	n e	0.0	0.0	6
7	-2	4	29.41	29.19	11	-4	Clear	s	0.0	0.0	7
8	7	25	29.15	29.13	30	5	Clear	s	0.0	0.0	8
9	17	17	29.06	29.18	26	16	Cloudy	n w	0.0	trace	9
10	11	13	29.39	29.53	18	10	Clear	n	0.0	0.0	10
11	12	26	29.55	29.37	32	3	Clear	s	0.0	0.0	11
12	29	40	29.29	29.22	52	25	Clear	s	0.0	0.0	12
13	35	30	29.18	28.84	45	30	Cloudy	n	0.60	0.45	13
14	10	3	29.09	29.34	30	3	Cloudy	n	0.0	0.0	14
15	-4	12	29.39	29.36	20	-5	Clear	w	0.0	0.0	15
16	8	26	29.43	29.36	30	7	Clear	s	0.0	0.0	16
17	15	38	29.28	29.30	37	10	Clear	s	0.0	0.0	17
18	28	32	28.99	28.94	42	12	Cloudy	s	0.0	0.0	18
19	31	40	29.05	28.95	44	30	Cloudy	s w	0.0	0.0	19
20	42	47	28.87	28.62	57	37	Cloudy	s	0.15	0.0	20
21	35	34	28.74	28.92	50	33	Pt. cloudy	s w	0.0	0.0	21
22	30	39	29.09	28.92	42	28	Pt. cloudy	s e	0.0	0.0	22
23	38	47	20.83	28.95	56	33	Pt. cloudy	s	0.08	0.0	23
24	38	43	28.88	28.82	50	37	Cloudy	s	0.095	0.0	24
25	32	30	28.65	28.89	55	30	Cloudy	n w	0.045	0.45	25
26	23	22	29.05	29.13	51	22	Pt. cloudy	n	0.0	0.0	26
27	15	18	29.14	29.18	23	13	Clear	n w	0.0	0.0	27
28	17	26	29.17	28.98	27	13	Pt. cloudy	s	0.0	0.0	28
Sum	548	664	816.20	815.82	959	443			1.12	2.40	
Average	19.5	23.7	29.15	29.13	34.2	15.8					

Meteorological observations for the month of March 1903, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	26	34	28.81	28.81	34	23	Cloudy	s e	0.07	0.27	1
2	29	34	28.87	28.71	34	24	Cloudy	s e	0.75	0.0	2
3	42	36	28.41	28.75	42	33	Cloudy	s e	0.045	0.0	3
4	30	29	28.60	28.88	32	22	Cloudy	s	0.047	0.47	4
5	22	27	29.29	29.39	27	22	Pt. cloudy	e	0.0	0.0	5
6	24	28	29.39	29.21	29	23	Pt. cloudy	s e	0.0	0.0	6
7	30	35	29.14	28.88	35	29	Cloudy	s	0.07	0.72	7
8	33	35	28.73	28.67	37	33	Cloudy	s	0.0	0.0	8
9	30	32	28.64	28.57	37	27	Cloudy	w	0.05	0.56	9
10	29	31	28.68	28.18	37	26	Cloudy	n w	0.0	0.0	10
11	25	28	28 98	28.08	31	22	Cloudy	n w	0.80	0.85	11
12	15	21	29.27	29.31	28	13	Pt. cloudy	n w	0.05	0.52	12
13	19	22	29.22	29.08	26	16	Cloudy	s e	0.04	0.423	13
14	16	18	29.16	29.09	24	15	Cloudy	n	0.0	0.0	14
15	12	17	29.02	28.98	21	11	Pt. cloudy	n	0.0	0.0	15
16	16	15	28.94	28.99	17	12	Pt. cloudy	e	0.02	0.22	16
17	15	17	29.11	29.18	24	15	Pt. cloudy	s w	0.0	trace	17
18	22	27	29.19	29.28	28	17	Clear	s	0.0	0.0	18
19	23	23	29.04	28.82	23	23	Cloudy	n e	0.45	4.50	19
20	16	22	28.88	28.75	23	14	Pt. cloudy	s w	0.0	0.0	20
21	17	21	28.61	28.72	22	14	Pt. cloudy	w	0.03	0.33	21
22	9	12	28.96	29.19	12	9	Pt. cloudy	n w	0.02	0.20	22
23	12	16	29.53	29.61	17	-1	Clear	s e	0.0	0.0	23
24	10	23	29.62	29.50	25	9	Clear	e	0.0	0.0	24
25	22	33	29.45	29.21	33	13	Clear	s e	0.0	0.0	25
26	39	50	28.85	28.56	51	30	Cloudy	s	0.17	0.0	26
27	35	34	28.62	28.97	35	33	Cloudy	n w	0.0	0.0	27
28	32	37	29.09	29.10	37	30	Pt. cloudy	n e	0.0	0.0	28
29	33	40	29.14	28.95	41	29	Clear	n e	0.0	0.0	29
30	35	37	28.81	28.69	40	33	Pt. cloudy	n e	0.0	0.0	30
31	27	30	28.95	....	38	30	Clear	n e	0.0	0.0	31
Sum	745	864	899.00	867.71	940	651	....	....	1.892	9.063	....
Average	24.0	27.8	29.00	27.99	30.3	21.0	....	....	....	......	....

Meteorological observations for the month of April, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	29	39	28.09	28.20	41	35	Sunny	e	0.0	0.0	1
2	35	50	29.25	29.23	51	30	Pt. cloudy	s	0.0	0.0	2
3	43	57	29.31	29.17	57	38	Pt. cloudy	s	0.0	0.0	3
4	52	42	29.04	29.03	53	42	Pt. cloudy	w	0.0	0.0	4
5	33	33	28.92	28.76	42	29	Cloudy	w	0.04	0.0	5
6	32	42	28.97	29.01	42	28	Pt. cloudy	w	0.0	0.0	6
7	....	53	28.91	29.00	53	30	Pt. cloudy	s w	0.0	0.0	7
8	40	40	29.05	28.81	52	39	Cloudy	e	0.66	0.0	8
9	53	42	28.48	28.64	42	40	Cloudy	s	0.14	0.0	9
10	38	42	28.74	28.93	42	38	Cloudy	w	0.0	0.0	10
11	41	52	29.05	29.05	52	40	Pt. cloudy	w	0.0	0.0	11
12	47	56	29.12	29.13	56	40	Sunny	n e	0.0	0.0	12
13	49	64	29.03	28.81	64	43	Pt. cloudy	s	0.82	0.0	13
14	56	46	28.56	28.67	56	46	Cloudy	w	0.07	0.0	14
15	37	38	28.91	29.13	39	38	Cloudy	n	0.0	0.0	15
16	35	48	29.31	29.30	48	30	Sunny	w	0.0	0.0	16
17	40	56	29.36	29.28	56	35	Sunny	s w	0.0	0.0	17
18	48	62	29.29	29.10	62	43	Sunny	s	0.0	0.0	18
19	53	56	29.06	29.00	56	47	Pt. cloudy	s	0.03	0.0	19
20	45	60	29.05	28.85	60	37	Sunny	w	0.0	0.0	20
21	49	51	28.80	28.81	51	34	Pt. cloudy	n	trace	0.0	21
22	43	34	28.75	28.93	44	34	Cloudy	n w	0.015	trace	22
23	34	43	29.12	29.08	50	30	Sunny	n w	0.0	0.0	23
24	38	52	29.05	28.78	52	31	Sunny	s	0.0	0.0	24
25	48	58	28.68	28.64	58	41	Sunny	e	0.35	0.0	25
26	50	61	28.65	28.68	61	46	Pt. cloudy	s e	0.09	0.0	26
27	51	63	28.77	28.78	63	45	Sunny	s e	0.0	0.0	27
28	45	56	28.97	28.86	56	39	Sunny	e	0.0	0.0	28
29	59	62	28.85	28.83	62	44	Pt. cloudy	s w	0.08	0.0	29
30	48	60	29.03	29.02	60	45	Pt. cloudy	w	0.0	0.0	30
Sum	1,271	1,518	868.17	867.54	1,581	1,137	......	......	2.295	....	...
Average	43.4	50.6	28.93	28.91	52.7	40.5	....	....	....	......	....

Meteorological observations for the month of May, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	54	55	29.04	28.77	55	47	Cloudy	s e	0.33	0.0	1
2	59	49	28.60	28.66	49	47	Cloudy	s w	0.32	0.0	2
3	45	56	28.76	28.60	56	43	Pt. cloudy	w	0.02	0.0	3
4	63	51	28.50	28.63	52	51	Pt. cloudy	s	0.0	0.0	4
5	47	53	28.77	28.75	60	42	Pt. cloudy	s	0.0	0.0	5
6	49	41	28.83	28.86	54	41	Pt. cloudy	w	0.0	0.0	6
7	39	41	28.97	29.06	44	33	Pt. cloudy	w	0.0	0.0	7
8	37	36	28.93	28.78	54	32	Cloudy	n e	0.31	0.0	8
9	37	41	29.10	29.10	44	30	Cloudy	n w	0.03	trace	9
10	37	52	29.12	29.04	56	31	Pt. cloudy	n w	0.0	0.0	10
11	51	67	29.08	29.00	70	44	Pt. cloudy	w	0.09	0.0	11
12	65	73	28.93	28.89	82	49	Pt. cloudy	s w	0.03	0.0	12
13	66	52	29.03	29.05	73	51	Cloudy	w	0.97	0.0	13
14	48	58	29.17	29.16	61	47	Cloudy	e	0.02	0.0	14
15	55	74	29.17	28.07	82	48	Clear	s	0.0	0.0	15
16	68	76	29.11	29.02	84	57	Clear	s	0.0	0.0	16
17	73	78	29.01	28.87	80	65	Clear	s	0.0	0.0	17
18	68	62	28.86	28.79	82	62	Clear	s	0.0	0.0	18
19	50	56	28.95	28.98	63	47	Pt. cloudy	n	0.0	0.0	19
20	51	57	29.11	28.99	63	37	Pt. cloudy	n e	0.0	0.0	20
21	52	63	29.07	28.92	70	44	Pt. cloudy	e	0.0	0.0	21
22	62	73	28.94	28.92	84	50	Clear	s	0.0	0.0	22
23	70	74	29.02	28.96	83	55	Pt. cloudy	s	0.0	0.0	23
24	69	68	28.95	28.88	85	64	Cloudy	s	0.0	0.0	24
25	69	74	28.85	28.69	85	60	Pt. cloudy	w	0.0	0.0	25
26	67	47	28.67	28.72	75	47	Cloudy	n	trace	0.0	26
27	44	39	28.73	28.79	49	39	Cloudy	n e	0.57	0.0	27
28	48	54	28.92	28.98	60	39	Clear	n	0.0	0.0	28
29	53	60	29.10	29.02	65	35	Clear	e	0.0	0.0	29
30	49	60	29.06	28.85	61	48	Cloudy	s e	0.36	0.0	30
31	57	73	28.87	28.82	80	50	Cloudy	s	0.0	0.0	31
Sum	1,702	1,813	897.22	894.60	2,061	1,435			3.05		
Average	54.9	58.4	28.94	28.85	66.4	46.2					

Meteorological observations for the month of June, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	64	62	28.86	28.89	74	55	Clear	s w	0.0	0.0	1
2	55	67	29.01	29.03	72	47	Pt. cloudy	w	0.0	0.0	2
3	66	73	29.15	29.03	78	48	Clear	s	0.0	0.0	3
4	68	73	28.99	28.67	81	59	Pt. cloudy	s	0.12	0.0	4
5	70	71	28.83	28.66	78	67	Pt. cloudy	s w	0.04	0.0	5
6	69	80	28.68	28.66	85	63	Pt. cloudy	s	0.0	0.0	6
7	75	76	28.64	28.58	85	70	Cloudy	s	1.03	0.0	7
8	69	68	28.73	28.67	82	67	Cloudy	s	1.05	0.0	8
9	70	72	28.79	28.72	80	64	Pt. cloudy	s w	0.85	0.0	9
10	68	57	28.73	29.00	72	62	Pt. cloudy	w	0.75	0.0	10
11	54	57	29.08	29.10	70	43	Clear	e	0.0	0.0	11
12	56	60	29.21	29.19	65	40	Clear	e	0.0	0.0	12
13	56	62	29.21	29.04	71	43	Clear	n e	0.0	0.0	13
14	60	70	28.99	28.85	75	55	Pt. cloudy	e	0.03	0.0	14
15	66	62	28.86	28.82	71	58	Pt. cloudy	s w	0.05	0.0	15
16	68	67	28.86	28.79	73	55	Cloudy	w	0.04	0.0	16
17	64	72	28.86	28.80	75	60	Pt. cloudy	n	0.0	0.0	17
18	62	66	28.79	28.72	73	61	Pt. cloudy	e	0.05	0.0	18
19	61	70	28.66	28.62	80	60	Cloudy	e	0.0	0.0	19
20	67	59	28.62	28.74	76	59	Pt. cloudy	s	0.08	0.0	20
21	63	62	28.89	28.72	67	52	Pt. cloudy	s w	0.32	0.0	21
22	54	57	28.64	28.68	63	52	Pt. cloudy	s w	0.03	0.0	22
23	58	66	28.78	28.86	70	47	Clear	s w	0.0	0.0	23
24	72	73	29.02	28.99	79	49	Pt. cloudy	w	0.0	0.0	24
25	68	74	29.06	28.98	83	57	Clear	n e	0.0	0.0	25
26	68	77	28.98	28.93	84	61	Pt. cloudy	e	0.0	0.0	26
27	70	77	29.00	28.90	85	60	Pt. cloudy	w	0.0	0.0	27
28	72	82	29.04	28.92	88	68	Pt. cloudy	s	0.0	0.0	28
29	80	72	28.96	28.86	90	71	Pt. cloudy	s w	0.0	0.0	29
30	68	72	28.84	28.91	81	66	Pt. cloudy	s	0.07	0.0	30
Sum	1,961	2,056	866.76	865.33	2,306	1,719			4.51	0.0	
Average	65.4	68.5	28.89	28.84	76.9	57.3					

Meteorological observations for the month of July, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	69	68	28.96	28.97	69	60	Pt. cloudy	s w	0.0	0.0	1
2	65	69	28.84	28.84	80	62	Cloudy	n	0.16	0.0	2
3	68	64	28.85	28.80	73	63	Cloudy	n e	0.0	0.0	3
4	65	67	28.91	29.08	78	64	Pt. cloudy	w	0.0	0.0	4
5	60	64	29.28	29.30	73	51	Pt. cloudy	n	0.0	0.0	5
6	59	66	29.34	29.27	75	47	Clear	n	0.0	0.0	6
7	65	75	29.21	29.09	83	55	Pt. cloudy	e	0.0	0.0	7
8	67	76	29.04	29.96	82	64	Pt. cloudy	s	0.13	0.0	8
9	71	76	28.93	28.91	85	59	Pt. cloudy	s w	0.0	0.0	9
10	74	71	28.95	29.03	84	66	Pt. cloudy	n	0.0	0.0	10
11	66	72	29.11	29.09	84	66	Clear	e	0.0	0.0	11
12	67	77	29.12	29.01	85	52	Clear	s e	0.0	0.0	12
13	71	76	29.00	28.94	89	61	Pt. cloudy	s e	0.0	0.0	13
14	72	78	28.97	28.88	88	65	Cloudy	e	0.0	0.0	14
15	73	75	28.87	28.80	85	66	Pt. cloudy	s	0.0	0.0	15
16	65	67	28.84	28.83	79	65	Pt. cloudy	s	0.03	0.0	16
17	66	68	28.83	28.86	78	53	Clear	s w	0.0	0.0	17
18	66	72	29.05	29.05	82	52	Clear	s w	0.0	0.0	18
19	70	76	29.07	28.95	82	60	Pt. cloudy	s e	0.0	0.0	19
20	74	77	28.93	28.91	86	69	Pt. cloudy	s e	0.0	0.0	20
21	72	82	28.91	28.83	90	62	Pt. cloudy	s w	0.0	0.0	21
22	76	82	28.77	28.69	93	64	Pt. cloudy	s w	0.35	0.0	22
23	62	67	28.89	28.96	82	57	Clear	n	0.0	0.0	23
24	63	75	28.07	29.00	79	58	Clear	e	0.0	0.0	24
25	67	72	29.08	28.96	82	56	Clear	s	0.0	0.0	25
26	69	62	28.93	28.85	84	58	Pt. cloudy	s	0.16	0.0	26
27	67	72	28.83	28.82	78	62	Pt. cloudy	s	0.66	0.0	27
28	64	67	28.86	28.75	86	59	Pt. cloudy	s e	0.27	0.0	28
29	68	68	28.62	28.70	74	66	Pt. cloudy	e	0.47	0.0	29
30	68	73	28.77	28.84	82	59	Clear	n w	0.0	0.0	30
31	64	71	28.97	29.04	81	59	Cloudy	n	0.0	0.0	31
Sum	2,093	2,234	897.88	893.01	2,531	1,860			2.23	0.0	
Average	67.5	72.0	28.93	28.93	81.6	60.0					

Meteorological observations for the month of August, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	65	75	29.14	29.16	84	61	Pt. cloudy	n e	0.0	0.0	1
2	67	76	29.22	29.13	88	57	Clear	e	0.0	0.0	2
3	70	78	29.10	29.02	90	62	Pt. cloudy	e	0.0	0.0	3
4	75	78	29.02	28.96	92	67	Clear	s w	0.0	0.0	4
5	77	78	28.98	28.98	89	69	Pt. cloudy	s w	0.0	0.0	5
6	72	76	29.03	29.03	83	70	Pt. cloudy	s	0.0	0.0	6
7	68	70	29.03	28.92	80	68	Cloudy	s e	0.87	0.0	7
8	69	76	28.96	28.88	81	69	Pt. cloudy	n e	0.0	0.0	8
9	69	69	28.90	28.79	82	67	Pt. cloudy	s e	0.59	0.0	9
10	68	75	28.78	28.87	80	66	Cloudy	s	0.36	0.0	10
11	68	69	28.78	28.96	86	63	Pt. cloudy	s	0.03	0.0	11
12	60	68	29.18	29.09	78	51	Clear	n	0.0	0.0	12
13	66	69	29.15	29.03	81	51	Clear	n	0.0	0.0	13
14	64	74	29.01	28.91	84	55	Clear	s w	0.0	0.0	14
15	71	77	28.93	28.89	86	57	Clear	s e	0.0	0.0	15
16	70	75	28.92	28.91	87	62	Pt. cloudy	e	0.0	0.0	16
17	68	77	29.00	28.96	87	65	Cloudy	e	0.0	0.0	17
18	71	72	29.06	29.02	86	68	Pt. cloudy	n e	0.0	0.0	18
19	71	76	29.07	28.97	84	68	Pt. cloudy	s	0.96	0.0	19
20	71	80	29.03	28.95	90	70	Pt. cloudy	s e	0.0	0.0	20
21	73	77	28.96	28.91	92	70	Pt. cloudy	s	0.0	0.0	21
22	75	75	28.89	28.83	92	69	Pt. cloudy	s	0.35	0.0	22
23	75	68	28.83	28.93	89	68	Cloudy	n w	0.12	0.0	23
24	66	68	29.03	28.97	72	65	Cloudy	n e	0.0	0.0	24
25	67	76	28.98	28.90	89	63	Cloudy	s	1.03	0.0	25
26	75	73	28.82	28.78	87	70	Cloudy	s w	0.04	0.0	26
27	60	63	29.04	28.95	74	56	Clear	n w	0.0	0.0	27
28	59	65	29.01	28.90	75	57	Clear	s	0.0	0.0	28
29	62	72	28.81	28.80	84	57	Clear	s w	0.0	0.0	29
30	64	63	28.95	28.93	76	57	Pt. cloudy	s w	0.0	0.0	30
31	65	63	29.00	29.08	76	55	Clear	s	0.0	0.0	31
Sum	2,121	2,024	898.61	897.41	2,604	1,953			4.35	0.0	
Average	68.4	65.3	28.99	28.94	84	63					

Meteorological observations for the month of September, 1903, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	56	67	29.22	29.03	75	43	Pt. cloudy	s e	0.0	0.0	1
2	69	72	28.83	28.71	80	63	Cloudy	s	0.0	0.0	2
3	65	64	28.84	28.93	76	62	Clear	n	0.0	0.0	3
4	55	62	29.10	29.10	76	46	Clear	n	0.0	0.0	4
5	61	68	29.16	29.08	82	48	Clear	....	0.0	0.0	5
6	59	72	29.15	29.03	87	51	Clear	s	0.0	0.0	6
7	62	74	29.04	28.94	88	54	Clear	....	0.0	0.0	7
8	65	73	28.96	28.86	88	55	Pt. cloudy	s	0.0	0.0	8
9	68	78	28.87	28.82	92	56	Clear	s	0.0	0.0	9
10	66	79	28.91	28.87	92	60	Pt. cloudy	s e	0.0	0.0	10
11	70	78	28.99	28.94	91	62	Clear	s e	0.0	0.0	11
12	72	75	28.91	28.79	90	63	Pt. cloudy	s	0.0	0.0	12
13	68	58	28.76	29.01	76	58	Pt. cloudy	n w	0.0	0.0	13
14	53	56	29.23	29.17	68	49	Pt. cloudy	n e	0.0	0.0	14
15	54	66	29.24	29.20	75	48	Clear	e	0.0	0.0	15
16	62	72	29.21	29.08	86	52	Clear	s e	0.0	0.0	16
17	65	79	29.12	29.03	93	61	Clear	s	0.0	0.0	17
18	70	77	29.08	29.00	93	61	Pt. cloudy	n	0.0	0.0	18
19	66	75	29.02	28.91	87	62	Cloudy	n	0.0	0.0	19
20	68	70	28.86	28.89	77	65	Pt. cloudy	s	0.10	0.0	20
21	67	75	29.03	28.90	85	65	Pt. cloudy	s	0.0	0.0	21
22	64	64	28.91	28.93	74	61	Pt. cloudy	s w	0.0	0.0	22
23	60	57	29.08	29.13	70	56	Clear	s e	0.0	0.0	23
24	48	57	29.26	29.21	70	40	Clear	e	0.0	0.0	24
25	53	70	29.20	28.99	80.5	48	Pt. cloudy	s e	0.0	0.0	25
26	67	63	28.99	29.09	76	62	Clear	s	0.0	0.0	26
27	51	58	29.24	29.22	72	42	Pt. cloudy	e	0.0	0.0	27
28	53	68	29.18	29.00	75	49	Pt. cloudy	e	0.0	0.0	28
29	66	58	28.88	29.00	70	59	Cloudy	s w	0.66	0.0	29
30	50	47	29.21	29.17	60	45	Clear	n	0.0	0.0	30
Sum	1,853	2,032	871.58	870.03	2,405	1,646	....	....	0.76	0.0	....
Average	61.8	67.7	29.05	29.00	80.1	54.9	....	....	....	......	....

Meteorological observations for the month of October, 1903, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	33.5	54	29.10	28.95	66	34	Clear	e	0.0	0.0	1
2	47	56	28.98	28.91	75	38	Clear	n e	0.0	0.0	2
3	47	64	28.96	28.84	74	43	Pt. cloudy	e	0.0	0.0	3
4	63	65	28.80	28.74	70	60	Pt. cloudy	s	0.07	0.0	4
5	61	55	28.69	28.74	68	54	Pt. cloudy	w	0.07	0.0	5
6	47	44	28.69	28.80	54	42	Cloudy	w	0.16	0.0	6
7	44	50	28.77	28.91	55	40	Cloudy	n	0.03	0.0	7
8	48	56	28.79	28.54	74	40	Cloudy	s	0.14	0.0	8
9	42.5	37	28.71	28.92	56	35	Cloudy	w	0.03	trace	9
10	30	30	28.91	28.94	40	28	Clear	w	0.0	trace	10
11	25.5	35	29.06	29.11	40	19	Pt. cloudy	w	0.0	0.0	11
12	31.5	46	29.19	29.16	53	24	Cloudy	w	0.0	0.0	12
13	47	54	29.16	29.28	70	41	Pt. cloudy	s	0.0	0.0	13
14	52	64	29.28	29.24	74	52	Pt. cloudy	s	0.0	0.0	14
15	50	60	29.25	29.14	74	44	Clear	s	0.0	0.0	15
16	53	62	29.16	29.05	75	50	Pt. cloudy	e	0.0	0.0	16
17	55	64	29.03	28.99	72	52	Clear	s e	0.0	0.0	17
18	54	58	28.91	28.73	64	52	Cloudy	s	0.23	0.0	18
19	52	51	28.83	29.04	62	50	Pt. cloudy	w	0.0	0.0	19
20	43	53	29.20	29.21	63	37	Clear	e	0.0	0.0	20
21	46	48	29.25	29.18	62	41	Clear	n e	0.0	0.0	21
22	42	52	29.14	29.09	55	38	Pt. cloudy	e	0.0	0.0	22
23	41	47	29.13	29.07	54	40	Pt. cloudy	e	0.0	0.0	23
24	51	47	28.76	28.62	60	43	Pt. cloudy	s	0.46	0.0	24
25	41	43	28.68	28.84	48	40	Cloudy	s w	0.03	0.0	25
26	42.5	57	28.73	28.58	60	40	Cloudy	s w	0.13	0.0	26
27	51	41	28.24	28.54	52	39	Cloudy	w	0.81	0.0	27
28	35	34	28.87	28.93	42	34	Cloudy	n	0.0	0.0	28
29	31.5	34	28.97	28.84	40	28	Cloudy	s	0.20	2.0	29
30	31	28	29.10	29.30	34	28	Cloudy	n e	0.0	0.0	30
31	20	27	28.48	28.48	37	16	Clear	n	0.0	0.0	31
Sum	1,363	1,516	896.82	896.71	1,826	1,222			2.36	2.00	
Average	43.9	48.9	28.92	28.92	58.9	39.4					

Meteorological observations for the month of November, 1906, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	22.5	33	29.55	29.44	......	......	Clear	s	0.0	0.0	1
2	28	41	29.41	29.29	51	27	Clear	s	0.0	0.0	2
3	35	45	29.36	29.35	50	30	Cloudy	n e	0.0	0.0	3
4	41.5	43	29.29	29.20	51	37	Pt. cloudy	s e	0.0	0.0	4
5	34	46	29.19	29.14	53	33	Pt. cloudy	s e	0.0	0.0	5
6	33	46	29.24	29.18	52	34	Clear	e	0.0	0.0	6
7	44	45	29.17	29.10	46	42	Cloudy	s e	0.09	0.0	7
8	42	47	29.08	29.01	59	42	Pt. cloudy	s e	0.0	0.0	8
9	48	42	28.84	28.94	50	41	Cloudy	w	0.0	0.0	9
10	28	37	28.90	28.78	42	37	Cloudy	w	0.07	0.0	10
11	33	28	29.79	28.90	36	28	Cloudy	n w	0.0	0.0	11
12	26	31	28.92	28.94	32	22	Cloudy	n w	0.075	0.75	12
13	27	26	28.88	28.83	34	25	Pt. cloudy	w	0.0	0.0	13
14	24	32	28.81	28.75	36	17	Pt. cloudy	e	0.0	0.0	14
15	26	30	28.80	28.82	42	25	Clear	e	0.0	0.0	15
16	30	37	28.93	28.90	47	24	Cloudy	s	0.08	0.0	16
17	41	49	28.44	28.55	52	36	Cloudy	s	0.0	0.36	17
18	39	37	28.52	28.94	49	37	Pt. cloudy	n w	0.07	0.27	18
19	31	33	29.23	29.22	46	30	Cloudy	s w	0.03	0.01	19
20	31.5	36	29.15	29.00	36	30	Cloudy	e	0.12	0.60	20
21	37	37	28.77	28.44	55	36	Cloudy	s w	0.30	0.76	21
22	36	35	28.90	29.22	37	21	Cloudy	w	0.0	0.02	22
23	32.5	37	29.36	29.32	41	32	Pt. cloudy	w	0.0	0.0	23
24	27	32	29.36	29.27	40	23	Clear	w	0.0	0.0	24
25	34	41	29.18	29.04	47	28	Cloudy	s	0.12	0.04	25
26	42	40	28.79	28.90	54	40	Cloudy	s w	0.04	0.28	26
27	38	36	29.03	29.22	41	34	Cloudy	w	0.0	0.02	27
28	34	32	29.19	29.42	40	17	Pt. cloudy	n w	0.0	0.0	28
29	25	32	29.48	29.37	40	8	Pt. cloudy	e	0.0	0.0	29
30	35	41	29.16	29.11	41	15	Cloudy	s w	0.06	0.0	30
Sum	1,015	1,127	872.72	871.59	1,300	851	......	......	1.055	3.11	......
Average	33.8	37.5	29.09	29.05	48.2	29.3	......	......	......	......	......

Meteorological observations for the month of December, 1903, at Agricultural College, East Lansing, Mich.

Day of month.	Thermometer in open air.		Barometer reduced to freezing point.		Registering thermometers.		Character of day.	Prevailing wind direction.	Precipitation.		Day of month.
	7 a. m.	7 p. m.	7 a. m.	7 p. m.	Maximum.	Minimum.			Inches, rain or melted snow.	Snowfall, inches.	
1	31	22	29.24	29.29	41	14	Cloudy	n w	0.0	0.0	1
2	26	34	29.22	28.76	34	25	Cloudy	s w	trace	trace	2
3	32	18	28.82	29.15	36	18	Pt. cloudy	n	0.0	0.0	3
4	19	36	29.14	29.00	36	15	Cloudy	s	0.0	0.0	4
5	27	32	29.04	28.64	36	25	Cloudy	e	0.32	1.50	5
6	32	21	28.30	28.95	39	21	Pt. cloudy	w	0.04	trace	6
7	14	15	29.25	29.29	22	12	Cloudy	n w	0.0	0.125	7
8	18	32	29.07	28.98	33	13	Cloudy	s e	0.0	0.0	8
9	22	28	29.19	29.23	32	21	Cloudy	s e	0.0	0.0	9
10	32	31	29.16	29.38	33	26	Cloudy	n	0.29	0.0	10
11	19	28	29.51	29.42	32	19	Clear	s	0.0	0.0	11
12	29	38	29.18	28.89	42	25	Clear	s w	0.0	0.0	12
13	38	35	28.83	28.97	40	32	Cloudy	e	0.10	0.0	13
14	37	44	28.93	28.85	48	34	Cloudy	s e	0.06	0.0	14
15	30	26	28.92	29.07	44	24	Cloudy	w	0.03	0.0	15
16	23	34	29.11	29.03	34	24	Clear	w	0.0	0.0	16
17	22	23	29.12	29.30	30	20	Cloudy	n	0.0	0.0	17
18	10.5	26	29.49	29.48	26	9	Clear	e	0.0	0.0	18
19	15	22	29.38	29.15	29	13	Clear	s e	0.0	0.0	19
20	20	29	28.97	28.79	30	15	Pt. cloudy	s e	0.0	0.0	20
21	25	29	28.76	28.80	30	22	Pt. cloudy	w	0.25	2.50	21
22	22	18	28.95	29.08	29	18	Pt. cloudy	n	0.0	trace	22
23	10	13	29.32	29.37	23	6	Clear	n	0.0	0.0	23
24	4	14	29.41	29.35	21	3	Clear	n	0.0	0.0	24
25	8	19	29.30	29.20	25	5	Clear	n w	0.0	0.0	25
26	22	31	....	28.84	31	10	Cloudy	s w	0.0	0.0	26
27	34	30	28.71	28.89	32	29	Cloudy	s w	0.0	0.0	27
28	30	34	28.98	28.92	32	28	Cloudy	s	0.0	0.0	28
29	31	35	29.18	29.12	33	28	Cloudy	s	0.0	0.0	29
30	33	40	28.97	28.62	40	30	Cloudy	e	0.50	0.0	30
31	42	34	28.53	28.71	48	33	Cloudy	w	0.25	0.0	31
Sum	757.5	871	872.98	900.52	1,041	617			1.84	4.125	
Average	24.4	28.0	28.16	29.04	33.5	19.9					

BULLETINS

OF THE

AGRICULTURAL COLLEGE EXPERIMENT STATION

ISSUED DURING THE

YEAR ENDING JUNE 30, 1907.

EXPERIMENT STATION BULLETINS.

FERTILIZER ANALYSES.

BY ANDREW J. PATTEN AND DOROTHEA MOXNESS.

Bulletin No. 239.

The inspection and analyses of the commercial fertilizers offered for sale in Michigan are made under authority of an act of the Legislature, approved March 10, 1885. The full text of the law has been printed in former bulletins, and its salient points alone will be referred to here. It provides that all commercial fertilizers, retailing for more than ten dollars per ton, shall be accompanied by a statement certifying the number of net pounds in the given sack, the brand, name and address of the manufacturer, and a chemical analysis stating the percentages of nitrogen, of potash, soluble in water, of available (soluble or reverted) phosphoric acid, and the insoluble phosphoric acid. (Sec. 1.) It provides that the manufacturer, importer or agent (the latter only in case the manufacturer fails to comply with the law), shall pay annually a license fee of twenty dollars for each brand offered for sale. (Sec. 3.) It provides that any person offering unguaranteed or over-guaranteed goods, shall be subject to a fine. (Sec. 6.) The full text will be furnished on application.

RESULTS OF INSPECTION.

A study of the tables of analyses following shows that 58 of the brands are two-tenths of one per cent, or more below their legal guarantees in one or more constituents. Sixteen are below their legal guarantees in more than one constituent, and 34 fail to furnish a commercial equivalent in promised plant food.

This is a condition of affairs that should not exist. While it is acknowledged that the nature of the materials used in the manufacture of commercial fertilizers is such as to render perfect mixing almost impossible and that consequently some variation from the guarantees should be expected, still it is certainly true that more than 75 per cent should equal in value the amount of plant food promised.

The larger number of firms selling fertilizers in the State are unquestionably attempting to comply with the requirements of the law in regard to the composition of their fertilizers and are doing so as nearly as can be expected. The analyses show, however, that there are a few firms whose goods are so far below the legal guarantees as to indicate gross carelessness in mixing, or a deliberate attempt to defraud. Many of the brands below their guarantees this year were the offenders last year. The facts are given in the bulletin, and it is for the farmers to decide whether they will any longer buy from firms whose goods habitually fail to furnish an equivalent in value of plant food guaranteed.

Manufacturers are supposed to know the composition of the materials used in the mixing of their brands and also of the separate brands when offered for sale, and they are at liberty to make any guarantee they

may desire. But after the guarantees are made, the manufacturer should be made to adhere to it so closely that the essential character of a brand is maintained, and its value shall not fall far below the value of the guarantee.

PRICES USED IN VALUATION OF FERTILIZERS.

In determining comparative values of fertilizers, the following prices have been used: Nitrogen, 17½ cents per pound; potash, soluble in water, 6 cents per pound; available phosphoric acid, 6 cents per pound; in bone, total phosphoric acid, 3½ cents per pound; in mixed fertilizers containing nitrogen, insoluble phosphoric acid, 2 cents per pound; in fertilizers containing no nitrogen, no value is given to insoluble phosphoric acid.

It must be distinctly understood that these prices are not intended to represent the agricultural value of the fertilizer; that is, the return which may be expected from its use. Neither do they represent the retail cost to the farmer, of the several elements in mixed fertilizers, but they simply represent approximately the cost of the different elements in the raw and unmixed materials.

They are used solely for the purpose of comparing the value of the fertilizers as guaranteed by the manufacturers with the value of the samples analyzed. These prices are often useful to the farmer in comparing the relative values of two or more similar brands offered by different manufacturers.

BRAND NAMES.

In making their purchases, buyers should not be guided too much by brand names, for they may or may not bear any relation to the usefulness of the goods. The words "guano," "dissolved bone," "high grade," etc., very often have no significance and, in fact, may be misnomers; and it often happens that the so-called special fertilizers but poorly suit the nature of the crops whose names they bear. There are no mysterious properties imparted to a fertilizer through its name whereby the plant-food it contains is better suited for the requirements of one certain crop than another; the plant-food contained in a fertilizer branded "Potato or "Sugar Beet Special" will supply the requirements of a corn or wheat crop just as well as those of the crop for which it is named.

Brand names are entirely unnecessary, and it would be much to the advantage of the farmer if he would always buy his fertilizers on the basis of the plant-food they are guaranteed to contain.

PURCHASE AND USE OF COMMERCIAL FERTILIZERS.

Commercial fertilizers should not be used as a substitute for farm manures, but rather to supplement them.

The amount and kinds of artificial plant-food to be used should be determined solely by three factors, namely (a) condition of the soil, (b) requirement of the crop to be grown, and (c) amount of natural farm manures available.

If a soil is deficient in nitrogen and phosphoric acid and contains a

liberal supply of available potash, and if the natural resources of the farm are insufficient to supply the deficiencies, then a fertilizer containing the lacking elements in liberal quantities should be used, and it would manifestly be poor economy to add potash to the already sufficient supply. On the other hand, if potash is the lacking element, then it should be supplied; it may, however, happen that a sufficient supply of all three elements is lacking, in which case a complete fertilizer should be used.

The question naturally arises then, how is the farmer to tell when his soil is deficient in plant-food?

First of all, let it be clearly understood that a chemical analysis is of no avail in determining this point, because it reveals only the total amount of plant food present in the soil without giving any idea of its availability. A soil may contain a great abundance of plant-food, but if it is present in an unavailable form, it is of no more benefit to the growing crop than so much quartz sand.

The only way, then, by which a farmer may ascertain whether his soil is deficient in any one or more of the elements of plant-food, is by applying them singly and in combinations, and noting the effects produced upon the crops. If, for instance, the addition of nitrogen to the soil results in an increased yield, then it is safe to conclude that the soil is deficient in available nitrogen. In this way the effect of the other plant-food elements and the several possible combinations may be tested, the results carefully noted and compared with those of a check plot where nothing has been applied. That application which produces the largest yields and the greatest returns for the money invested and labor expended is, of course, the most economical and should be used in preference to any other.

The farmer should ever be an experimenter, and it is hoped that some of the points that have been briefly touched upon in this bulletin may be helpful to many.

LEGAL GOODS.

Twenty-one manufacturing companies have paid licenses required by law on 134 brands shown in the following tables. The sale of these brands, within the State during the season of 1906, and of these brands only, is legal.

Fertilene, manufactured and sold by Nathan Smith & Son, is intended solely for the use of florists and is sold at such a price as to prohibit its use by farmers.

Results of analyses of commercial fertilizers for 1906, expressed in parts in one hundred.

Laboratory No.	Manufacturer and Trade Name.		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Insoluble.	Phosphoric acid. Total.	Potash soluble in water.
1234	AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK, N. Y.: Bradley's Alkaline Bone and Potash	Claimed	....	11.	....	....	2.
		Found	....	11.85	.42	12.27	2.42
1235	Bradley's B. D. Sea Fowl Guano	Claimed	2.06	8.	....	....	1.50
		Found	**2.04**	7.97	1.93	9.90	1.78
1159	Bradley's Dissolved Bone with Potash	Claimed	1.	8.	....	....	2.
		Found	1.09	8.22	2.25	10.47	2.11
1158	Bradley's Niagara Phosphate	Claimed	.82	7.	....	....	1.
		Found	.82	7.63	1.37	9.	1.
1236	Bradley's Soluble Bone	Claimed	....	14.	....	....	....
		Found	....	13.93	.54	14.47	....
1206	Crocker's Ammoniated Bone Superphosphate	Claimed	2.46	9.	....	10.	2.
		Found	**2.42**	10.58	.79	11.37	1.93
1205	Crocker's Ammoniated Wheat and Corn Phosphate	Claimed	2.06	8.	....	10.	1.50
		Found	2.14	9.24	1.26	10.50	1.72
1233	Crocker's Dissolved Bone with Potash	Claimed	....	10.	....	....	2.
		Found	....	**9.17**	.93	10.10	2.08
1153	Crocker's General Crop Phosphate	Claimed	.82	7.	....	10.	1.
		Found	**.80**	**6.62**	1.91	**8.53**	1.26
1213	Crocker's New Rival Ammoniated Superphosphate	Claimed	1.23	9.	....	10.	2.
		Found	1.29	10.26	1.51	11.77	2.03
1152	Crocker's Universal Grain Grower	Claimed	.82	8.	....	9.	2.
		Found	.98	8.83	1.60	10.43	2.04
1168	Fine Ground Bone	Claimed	2.47	....	....	22.8	....
		Found	2.53	....	....	26.55	....
1204	High Grade Garden and Vegetable Fertilizer	Claimed	2.	8.	....	....	6.
		Found	2.01	9.56	1.07	10.63	6.08
1146	New York State Special	Claimed	.82	8.	....	10.	3.
		Found	.98	10.33	1.17	11.50	3.22

1232	Niagara Dissolved Bone with Potash	Claimed	....	10.	....	11.	2.
		Found	....	10.49	.11	**10.60**	2.13
1223	Niagara Grain and Grass Grower	Claimed	.82	7.	....	8.	1.
		Found	.88	7.25	1.52	8.77	1.17
1145	Niagara Potato and Vegetable Fertilizer	Claimed	2.06	8.	....	9.	3.
		Found	2.14	9.35	1.12	10.47	3.18
1222	Niagara Wheat and Corn Producer	Claimed	1.23	9.	....	10.	2.
		Found	1.29	9.75	2.02	11.77	2.28
1253	ARMOUR FERTILIZER WORKS, CHICAGO, ILL.:						
	Acidulated Bone Meal	Claimed	1.65	....	....	18.	....
		Found	2.13	....	....	20.8	....
1227	All Soluble	Claimed	2.88	8.	....	10.	4.
		Found	2.96	9.55	2.42	11.97	5.48
1247	Ammoniated Bone with Potash	Claimed	2.47	6.	....	8.	2.
		Found	2.47	6.82	1.65	8.47	2.71
1248	Banner Brand	Claimed	....	10.	....	12.	8.
		Found	....	10.01	.32	**10.33**	8.04
1170	Bean Grower	Claimed	.82	8.	....	10.	2.
		Found	.98	8.34	2.46	10.80	2.17
1230	Bone, Blood and Potash	Claimed	4.11	8.	....	10.	7.
		Found	**3.90**	8.93	2.14	11.07	7.45
1182	Bone Meal	Claimed	2.47	....	....	24.	....
		Found	2.44	11.21	13.93	25.14	....
1193	Fruit and Root Crop Special	Claimed	1.65	8.	....	10.	5.
		Found	**1.25**	9.96	1.17	11.13	5.10
1185	Grain Grower	Claimed	1.65	8.	....	10.	2.
1214		Found	**1.37**	8.19	3.08	11.27	2.
		Found	**1.43**	8.39	2.84	11.23	2.39
1249	German Kainit	Claimed	....	....	....	....	12.
		Found	....	....	....	....	12.14
1144	High Grade Potato	Claimed	1.65	8.	....	10.	10.
		Found	**1.15**	9.21	2.59	11.80	**8.85**
1250	Muriate of Potash	Claimed	....	....	....	....	48.
		Found	....	....	....	....	50.62
1251	Nitrate of Soda	Claimed	15.63	....	....	....	....
		Found	15.46	....	....	....	....
1252	Phosphate and Potash	Claimed	....	10.	....	12.	2.
		Found	....	10.58	.39	**10.97**	2.10

Results of analyses of commercial fertilizers for 1906, expressed in parts in one hundred.—Con.

Laboratory No.	Manufacturer and Trade Name.		Nitrogen.	Phosphoric acid.			Potash soluble in water.
				Available.	Insoluble.	Total	
1190	Star Phosphate	Claimed	....	14.	....	16.	....
		Found	....	16.30	.30	16.60	....
1255	Steamed Bone Meal	Claimed	1.65	....	....	20.	....
		Found	**1.41**	....	....	22.13	....
1254	Sugar Beet C	Claimed	1.65	8.	....	10.	10.
		Found	1.65	8.94	1.06	10.	10.88
1180	Sugar Beet Special	Claimed	.82	8.	....	10.	4.
		Found	**.79**	9.21	1.56	10.77	**3.95**
1154	Wheat, Corn and Oat Special	Claimed	.82	7.	....	9.	1.
		Found	1.01	7.55	2.14	9.69	1.53
	Robert Binder, Battle Creek, Mich.:						
1212	Blood and Bone	Claimed	5.25	....	....	13.17	.29
		Found	**4.95**	....	....	15.27	**.28**
	James Boland Fertilizer Works, Jackson, Mich.:						
1134	Blackman Brand General Crop Fertilizer	Claimed	1.25	7.	....	9.	1.25
		Found	2.92	**6.30**	8.20	14.50	1.26
1135	Blackman Sugar Beet, Onion and Potato	Claimed	2.50	10.	....	12.	3.
		Found	**2.08**	**8.50**	7.72	16.22	**2.04**
	Buffalo Fertilizer Co., Buffalo, N. Y.:						
1195	Ammoniated Bone Black	Claimed	1.23	8.	....	9.	2.50
		Found	1.14	8.61	3.29	11.90	2.56
1187	Bone Meal	Claimed	2.46	....	....	25.	....
1199		Found	2.77	....	....	**20.8**	....
		Found	2.73	....	....	**20.6**	....
1197	Celery and Potato Special	Claimed	1.64	8.	....	9.	10.
1276		Found	**1.37**	7.93	.92	8.85	**7.45**
		Found	**1.34**	8.23	1.10	9.33	**7.95**
1196	Farmers' Choice	Claimed	.82	8.	....	9.	5.
1172		Found	.88	8.52	1.35	9.87	**4.89**
		Found	.86	8.09	1.88	9.97	5.16

1184 1274	Garden Truck	Claimed Found Found	3.28 **1.90** **1.93**	8. 8.57 8.51	.... 1.03 1.16	9. 9.60 9.67	7. **6.28** **6.24**
1200	General Crop	Claimed Found	....	9. 8.99	.... 1.41	10. 10.40	3. **3.13**
1202	Kainit	Claimed Found	....	....	....	....	12. 12.75
1201	Muriate of Potash	Claimed Found	....	....	....	....	50. **44.25**
1203	Nitrate of Soda	Claimed Found	15.58 15.34	....	....	....	....
1268	Ohio and Michigan Special	Claimed Found	.82 **.73**	11. 11.08	.... 4.72	12. 15.80	1. 1.22
1198	Soluble Bone	Claimed Found	....	14. 15.41	.... .72	15. 16.13	....
1173 1181 1275	York State Special	Claimed Found Found Found	1.64 **.98** **1.31** **1.26**	9. **7.45** 9.05 9.52	.... 1.62 .88 .88	10. **9.07** 9.93 10.40	5. **4.22** **4.50** **4.78**
	CHICAGO FERTILIZER CO., CHICAGO, ILL.:						
1157	Bone, Blood and Potash	Claimed Found	1.23 **.55**	8. 10.13	.... 1.40	10. 11.53	2. **1.25**
1267	Potash Special	Claimed Found	.82 1.76	8. 8.97	.... 1.66	10. 10.63	4. 4.12
1179	Wheat and Corn Special	Claimed Found	.82 **.44**	7. 7.11	.... 3.19	9. 10.30	1. **.83**
	CINCINNATI PHOSPHATE CO', CINCINNATI, OHIO:						
1263	Capital Dissolved Bone and Potash	Claimed Found	....	12. 12.65	.... 1.42	13. 14.07	3. **2.99**
1264	Capital Grain and Grass Grower	Claimed Found	.80 **.76**	10. 12.40	.... 1.40	11. 13.80	1. 1.03
1265	Capital Tobacco, Potato and Beet Grower	Claimed Found	.80 **.74**	8. 9.51	.... 1.22	9. 10.73	4. **2.83**
1262	Capital Wheat Grower	Claimed Found	....	14. 16.58	.... 1.22	15. 17.80	....
	DARLING & CO., CHICAGO, ILL.:						
1160	Darling's Acid Phosphate	Claimed Found	....	10. 10.80	.... .53	.... 11.33	....

Results of Analyses of commercial fertilizers for 1906, expressed in parts in one hundred.—CON.

Laboratory No.	Manufacturer and Trade Name.		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Insoluble.	Phosphoric acid. Total.	Potash soluble in water.
1132	Darling's Chicago Brand	Claimed	1.65	8.	....	10.	2.
		Found	**1.61**	8.10	3.99	12.09	2.16
1130	Darling's Farmers' Favorite Brand	Claimed	2.47	8.	....	10.	4.
		Found	**2.09**	8.54	4.72	13.26	**3.67**
1269	Darilng's General Crop Brand	Claimed	.82	8.	....	10.	6.
		Found	.94	9.53	1.04	10.57	**5.55**
1270	Darling's Pure Bone and Potash	Claimed	2.14	....	....	20.13	6.
		Found	**1.80**	....	....	20.80	9.10
1151	Darling's Pure Ground Bone	Claimed	2.47	....	....	23.	....
		Found	2.79	....	....	24.70	....
1131	Darling's Sure Winner Brand	Claimed	.82	8.	....	10.	3.
		Found	**.73**	8.50	2.17	10.67	**2.72**
1133	Darling's Western Brand	Claimed	.41	7.	....	9.	.50
		Found	.63	7.83	.57	**8.44**	.60
1192	GRAND RAPIDS GLUE CO., GRAND RAPIDS, MICH.:						
	Grand Rapids Fertilizer	Claimed	1.65	8.	....	15.	1.
		Found	**1.97**	9.03	8.80	17.83	**.92**
1161	GRANGE FERTILIZER CO., DETROIT, MICH.:						
	Michigan Grange Complete Manure	Claimed	.82	7.	....	....	1.
		Found	.98	**6.68**	1.36	8.04	1.40
1239	Michigan Grange Corn, Oats and Grass	Claimed	1.64	8.	....	....	2.
		Found	1.72	9.	2.57	11.57	2.44
1238	Michigan Grange Potato and Vegetable Fertilizer	Claimed	.85	8.	....	....	4.
		Found	1.07	8.01	1.12	9.13	4.19
1241	Michigan Grange Wheat Fertilizer	Claimed	....	14.	....	....	....
		Found	....	**13.89**	.51	14.40	....
1240	Michigan Grange Wheat Fertilizer with Potash	Claimed	....	10.	....	....	2.
		Found	....	**9.87**	.86	10.73	2.04

1163	THE JARECKI CHEMICAL CO., SANDUSKY, OHIO: C. O. D. Phosphate	Claimed	....	14.	1.	....	....
		Found	....	14.80	.65	15.45	....
1183	Fish and Potash Grain Special	Claimed	1.25	9.	1.	....	2.
		Found	**1.10**	9.10	1.40	10.50	**1.73**
1162	Fish and Potash, Potato and Tobacco Food	Claimed	.82	8.	1.	....	4.
		Found	**.78**	8.16	1.77	9.93	**3.09**
1178	Lake Erie Fish Guano	Claimed	.82	10.	1.	....	2.
		Found	**.66**	10.55	1.25	11.80	**1.75**
1164	No. 1 Fish Guano	Claimed	.82	10.	1.	....	1.
1219		Found	**.68**	10.75	.65	11.40	**.86**
		Found	**.75**	**9.97**	1.93	11.90	1.13
1242	Onion and Truck Grower	Claimed	1.65	6.	1.	....	6.
		Found	1.93	**4.99**	1.88	6.87	7.87
1169	Special Sugar Beet Grower	Claimed	.82	8.	1.	....	4.
		Found	**.73**	8.40	.90	9.30	**3.76**
1167	Square Brand Phosphate and Potash	Claimed	....	10.	1.	11.	2.
		Found	....	10.11	1.59	11.70	2.69
1211	KALAMAZOO RENDERING & FERTILIZER CO., KALAMAZOO, MICH.: "Kazoo" Fertilizer	Claimed	5.50	3.	....	6.	4.
		Found	**3.02**	**2.20**	7.50	9.70	5.29
1149	MICHIGAN CARBON WORKS, DETROIT, MICH.: A-1 Potash	Claimed	.82	8.	....	10.	3.
1220		Found	.84	8.26	1.15	9.41	3.30
		Found	.88	9.	.97	9.97	3.14
1148	Homestead, A. Bone Black Fertilizer	Claimed	2.06	8.	....	9.	1.50
1215		Found	2.24	8.49	1.72	10.21	**1.41**
		Found	2.21	8.43	1.70	10.13	1.65
1143	Homestead High Grade Garden and Vegetable Fertilizer	Claimed	2	8.	....	....	6.
		Found	2.09	9.09	1.04	10.13	6.09
1147	Homestead Potato and Tobacco Fertilizer	Claimed	2.06	8.	....	9.	3.
		Found	**1.98**	9.63	1.22	10.85	**2.79**
1244	Homestead Special Beet Fertilizer	Claimed	1.64	9.	....	....	5.
		Found	**1.61**	9.03	1.70	10.73	5.45
1156	Homestead Sugar Beet Fertilizer	Claimed	1 23	9.	....	....	2.
		Found	1.38	9.59	2.14	11.73	2.19
1129	Muriate of Potash	Claimed	....	....	....	....	50.
		Found	....	....	....	....	**48.07**

Results of analyses of commercial fertilizers for 1906, expressed in parts in one hundred.—CON.

Laboratory No.	Manufacturer and Trade Name.		Nitrogen.	Phosphoric acid.			Potash soluble in water.
				Available.	Insoluble.	Total.	
1171	Red Line Complete Manure	Claimed	.82	7.	....	....	1.
		Found	.82	8.73	.80	9.53	**.93**
1246	Red Line Phosphate	Claimed	....	14.	....	....	....
		Found	....	14.59	.41	15.	....
1224	Red Line Phosphate with Potash	Claimed	....	10.	....	11.	2.
		Found	....	9.94	.33	**10.27**	2.31
1245	Wolverine Phosphate	Claimed	....	10.	....	....	....
		Found	....	11.32	.31	11.63	....
	NORTH WESTERN FERTILIZER CO., CHICAGO, ILL.:						
1237	Acidulated Bone and Potash	Claimed	.82	10.	....	....	1.
		Found	1.01	10.74	1.59	12.33	1.32
1210	Garden City Superphosphate	Claimed	2.05	8.	....	10.	1.50
		Found	1.98	9.	1.40	10.40	1.57
1189	Quick Acting Phosphate	Claimed	....	10.	....	....	....
		Found	....	10.02	1.15	11.17	....
1127	Horseshoe Corn and Wheat Grower	Claimed	1.64	8.	....	10.	2.
		Found	1.82	8.03	1.75	**9.78**	2.25
1174	Horseshoe High Grade Garden and Vegetable Fertilizer	Claimed	2	8.	....	....	6.
		Found	2.05	9.	1.28	10.28	6.31
1191	Horseshoe Potash and Manure	Claimed	.82	8.	....	....	3.
		Found	1.01	9.05	.65	9.70	3.56
1186	Horseshoe Potato Grower	Claimed	2.46	9.	....	....	2.
		Found	**2.20**	9.76	.84	10.60	**1.97**
1128	Horseshoe Sugar Beet Fertilizer	Claimed	1.23	9.	....	10.	2.
		Found	1.37	9.	2.87	11.87	2.35
	OHIO FARMERS FERTILIZER CO., CLEVELAND, OHIO:						
1175	Ammoniated Bone and Potash	Claimed	.82	8.	....	10.	4.
		Found	**.75**	**7.18**	3.02	10.20	4.18
1176	Corn, Oats and Wheat Fish Guano	Claimed	1.23	8.	....	10.	2.
		Found	**.59**	**6.45**	2.68	9.13	2.43

1221	General Crop Fish Guano	Claimed	.82	7.	...	9.	1.
		Found	**.42**	**6.17**	3.76	9.93	**.72**
	PHOENIX MANUFACTURING CO., ANN ARBOR, MICH.:						
1150	Huron Valley	Claimed	3.75	9.	...	18.	...
1155		Found	4.33	...	...	18.40	...
		Found	4.05	10.50	9.68	20.18	...
	NATHAN SMITH & SON, ADRIAN, MICH.:						
1177	Fertilene	Claimed	...	...	...	...	...
		Found	10.77	19.85	...	19.85	27.65
	SPEIDEL & SWARTZ, GRAND HAVEN, MICH.:						
1266	Celery Hustler	Claimed	7.	3.17	...	6.9	1.25
		Found	**5.77**	**2.69**	.38	**3.07**	1.85
	SWIFT & CO., CHICAGO, ILL.:						
1231	Swift's Bee-hive Fertilizer	Claimed	.82	8.	...	...	3.
		Found	**.79**	9.34	.66	10.	**2.91**
1137	Swift's Complete Fertilizer	Claimed	1.	8.	3.	11.	1.
		Found	1.09	8.33	1.85	10.18	1.64
1141	Muriate of Potash	Claimed	...	...	...	...	50.
		Found	...	...	...	...	57.29
1140	Nitrate of Soda	Claimed	15.	...	...	...	...
		Found	14.90	...	...	...	...
1138	Swift's Onion, Potato and Tobacco	Claimed	1.64	8.	3.	11.	7.
1217		Found	**1.45**	9.59	.43	10.02	**6.78**
		Found	**1.59**	8.13	1.97	10.10	7.06
1271	Swife's Pure Ammoniated Bone and Potash	Claimed	4.75	...	...	16.	3.
		Found	**4.13**	...	...	16.73	3.97
1272	Swift's Pure Bone and Potash	Claimed	2.50	...	...	23.50	3.
		Found	**1.97**	...	...	25.20	3.25
1225	Swift's Pure Bone Meal	Claimed	2.50	...	...	25.	...
		Found	**2.44**	...	...	25.14	...
1188	Swift's Pure Park and Lawn Fertilizer	Claimed	6.58	7.	...	...	...
		Found	**6.19**	7.39	.84	8.23	...
1273	Swift's Special Bone Meal	Claimed	.82	...	...	27.50	...
		Found	1.22	...	...	28.30	...
1166	Swift's Special Phosphate and Potash	Claimed	...	10.	.1	...	2.
		Found	...	12.84	.46	13.30	**1.66**
1207	Swift's Sugar Beet Grower	Claimed	2.50	8.	...	11.	5.
1282		Found	**.64**	**7.28**	.59	**7.87**	6.03
		Found	**2.48**	8.42	2.47	10.89	7.41

Results of analyses of commercial fertilizers for 1906, expressed in parts in one hundred.—CONCLUDED.

Laboratory No.	Manufacturer and Trade Name.		Nitrogen.	Phosphoric acid.			Potash soluble in water.
				Available.	Insoluble.	Total.	
1216	Swift's Superphosphate	Claimed	1.64	8.	....	12.	2.
1136		Found	**1.39**	**7.72**	2.28	10.	**1.80**
		Found	1.65	**7.44**	3.	10.44	2.01
1165	Swift's Truck Grower	Claimed	.82	8.	....	....	4.
1218		Found	**.77**	8.92	1.08	10.	**3.62**
		Found	.86	9.58	.32	9.90	4.10
1139	Swift's Vegetable Grower	Claimed	3.25	9.	1.	10.	10
		Found	**2.91**	**6.84**	4.66	11.50	10.82
1256	TUSCORARA FERTILIZER CO., CHICAGO, ILL.:						
	Acid Phosphate	Claimed	....	14.	....	16.	....
		Found	....	15.18	.30	15.48	....
1257	Ammoniated Phosphate	Claimed	.82	7.	....	9.	1.
		Found	.82	7.16	.64	**7.80**	1.03
1226	Bone and Potash	Claimed	....	10.	....	12.	2.
		Found	....	**8.77**	2.30	11.07	5.14
1229	Michigan Special	Claimed	1.64	8.	....	10.	5.
		Found	**1.21**	8.37	1.75	10.12	**4.33**
1228	Steamed Bone Meal	Claimed	1.64	....	....	20.	....
		Found	2.79	....	....	24.60	....
1258	Tuscarora Bone Phosphate	Claimed	....	10.	....	12.	....
		Found	....	10.18	.42	**10.60**	....
1259	Tuscarora Fruit and Potato	Claimed	1.65	8.	....	10.	10.
		Found	1.73	8.40	1.60	10.	10.95
1208	Tuscarora Garden	Claimed	2.88	8.	....	10.	4.
		Found	3.67	8.42	2.62	11.04	7.71
1209	Tuscorara Standard	Claimed	1.65	8.	....	10.	2.
		Found	**1.52**	**7.64**	2.63	10.27	2.08
1260	Tuscarora Trucker	Claimed	4.11	8.	....	10.	7.
		Found	**4.01**	8.75	3.55	12.30	8.32

1261	Wolverine Special	Claimed	.82	8	....	10	4
		Found	.83	8.63	.87	**9.50**	4.45
1243	WEPPNER & ADAMS, CHICAGO, ILL.:						
	Plant Food	Claimed	3	5.50	....	....	.50
		Found	**2.51**	**1.61**	.98	2.59	.47
1025	*CINCINNATI PHOSPHATE CO., CINCINNATI, OHIO:						
	Bonus, A. Humus Phosphate	Claimed	.20	14	....	15	....
		Found	.28	**12.65**	2.37	15.02	....
1026	Capital Alkaline Bone	Claimed	....	10	....	11	2
		Found	....	10.36	2.33	12.69	2.93
1027	Capital Dissolved Bone and Potash	Claimed	....	12	....	13	3
		Found	....	**10.96**	1.89	12.85	5.29
1028	Capital Grain and Grass Grower	Claimed	.80	10	....	11	1
		Found	**.79**	10.26	1.12	11.38	1.25
1029	Capital High Grade Guano	Claimed	.80	10	....	11	2
		Found	.93	**9.46**	1.58	11.04	2.14
1030	Capital Tobacco, Potato and Beet Grower	Claimed	.80	8	....	9	4
		Found	.75	9.03	1.29	10.32	**3.55**
1031	Capital Wheat Grower	Claimed	....	14	....	15	....
		Found	....	**13.48**	3.10	16.58	....

* The samples of the Cincinnati Phosphate Co., reported below were received in 1905 after the regular fertilizer bulletin had been issued.

ROOTS SUPPLEMENTARY TO SILAGE FOR DAIRY COWS.

BY R. S. SHAW AND H. W. NORTON, JR.

[The plans of this experiment were executed and the data prepared for publication by Mr. Norton.]

Bulletin No. 240.

The object of this series of experiments was to determine whether the addition of roots to a complete ration containing silage would increase the milk flow profitably, or not. It was in no sense a comparison of the values of silage and roots, as that question has been investigated heretofore and reported upon by the Pennsylvania Station, in bulletin 26, and by Ohio, in bulletin 50.

By the use of the term complete, as applied to the ration of the dairy cow in this case, we imply a proper balance with reference to the relative amounts of hay, silage, and concentrates when the cow is consuming all she cares for of each. An animal may be said to be on full feed as regards a certain ration and still may be induced to consume more if an additional factor, especially palatable, is added. Scientific and practical men agree that succulence is essential in the ration of the dairy cow, and some have claimed that silage furnishes this quality perfectly, hence the suggestion of this line of work. We should expect entirely different results where less than a full feed of silage was given and a marked advantage in favor of root feeding in a case where silage was not available.

GENERAL PLAN.

Three separate feeding trials were made and a total number of 40 cows used. In each case they were divided into two lots equal in number, and as nearly alike as possible from the standpoint of conditon of flesh, time from calving, and previous production when on the same feed. The feeding trials covered eight weeks, and were divided into two four-weeks periods. During the first period Lot 1 received roots in addition to the regular ration; during the second period Lot 2 received roots in addition, while Lot 1 received only the regular feed. Every cow was weighed three successive days at the beginning of the first period, at the beginning of the second and at the close of the second period, the averages being taken as the correct weights for each time.

Daily records were kept of all feed consumed and all milk produced, each milking being weighed and sampled, the samples preserved and tested weekly for butter fat.

All the cows under experiment were fed regularly, stabled alike, turned out to water once a day during the early spring, twice a day later, and given the same general care and treatment. Reversing the root feeding in the two periods, so that Lot 2 consumed the same amount of roots as Lot 1, tended to equalize any differences due to the individuality which would otherwise have rendered the results inaccurate. In order that the trials should be fairly comparable the same scale of prices was used in figuring the results, in both years, 1905 and 1906.

PRICES OF FEEDS.

Silage	$2.50 per ton.
Clover hay	5.00 per ton.
Roots	2.00 per ton.
Dried beet pulp	15.00 per ton.
Corn meal	20.00 per ton.
Oats	20.00 per ton.
Bran	18.00 per ton.
Gluten feed	20.00 per ton.
Oil cake	28.00 per ton.

Three grain mixtures were used, as follows:

Grain mixture No. 1 cost $17.60 per ton.

Dried beet pulp	4 parts.
Oats	3 parts.
Bran	2 parts.
Gluten feed	1 part.

Grain mixture No. 4 cost $20.28 per ton.

Bran	3 parts.
Corn meal	3 parts.
Oil cake	1 part.

Grain mixture No. 5 cost $19.21 per ton.

Bran	6 parts.
Corn meal	3 parts.
Dried beet pulp	3 parts.
Oil cake	2 parts.

FEEDING TRIAL—NUMBER ONE.

In the spring of 1905, sixteen cows of Grade Herd No. 1 were selected as described above and divided into two lots of eight cows each. During the first period of four weeks, Lot 1 received, in addition to the regular herd ration of silage, hay and grain, 15 pounds of roots per head daily. During the second period, Lot 2 received the same amount of roots instead of Lot 1. The last period, however, covered only two weeks, as the supply of roots at that time was exhausted and the results given herein are reported in weekly averages in order to furnish a fair basis for comparison. Lot 1 consisted of Nos. 11, 12, 14, 19, 21, 23, 24, 31. Lot 2, of Nos. 13, 17, 20, 22, 25, 27, 28, 32.

AVERAGE RATIONS CONSUMED.

Lot 1.

	First Period.	Second Period.
Silage	42.4 lbs. per day	42.9 lbs. per day
Hay	4.0 lbs. per day	3.8 lbs. per day
Grain (No. 1)	8.0 lbs. per day	8.1 lbs. per day
Roots	15.0 lbs. per day	

Lot 2.

	First Period.	Second Period.
Silage	46.1 lbs. per day	47.0 lbs. per day
Hay	4.0 lbs. per day	3.75 lbs. per day
Grain (No. 1)	8.0 lbs. per day	8.2 lbs. per day
Roots		15.0 lbs. per day

The average ration taken from both lots when fed roots as against both lots when off roots, is as follows

AVERAGE RATION FOR BOTH LOTS.

Lots 1 and 2 With Roots.		Lots 1 and 2 Without Roots.	
Silage	44.7 lbs.	Silage	44.5 lbs.
Hay	3.87 lbs.	Hay	3.90 lbs.
Grain	8.10 lbs.	Grain	8.05 lbs.
Roots	15.0 lbs.	Roots	00 lbs.

A comparison of the above table of rations shows a very slight difference in the rations as consumed during the two periods aside from the root factor.

The tables following show the production in milk and butter fat, cost of same, and cost of ration on the weekly average.

TABLE 1.—LOT 1.

ROOTS.

Averages for four weeks.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
11	167.5 lbs.	$1.108	$0.661	6.448 lbs.	$0.171
12	166.4 lbs.	.996	.598	6.903 lbs.	.144
14	188.3 lbs.	1.109	.588	7.202 lbs.	.153
19	136.6 lbs.	1.063	.778	6.441 lbs.	.165
21	126.5 lbs.	.968	.765	5.471 lbs.	.176
23	216.3 lbs.	1.008	.466	7.299 lbs.	.138
24	186.3 lbs.	1.052	.564	8.007 lbs.	.131
31	174.7 lbs.	1.011	.578	6.633 lbs.	.152
Average	170.32 lbs.	1.039	$0.6247	6.800 lbs.	$0.1537

NO ROOTS.

Averages for two weeks.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
11	162.9 lbs.	$1.023	$0.627	6.596 lbs.	$0.155
12	155.7 lbs.	.927	.595	6.385 lbs.	.145
14	177.3 lbs.	1.023	.576	7.181 lbs.	.142
19	135.6 lbs.	.943	.695	6.104 lbs.	.154
21	126.7 lbs.	.905	.714	5.323 lbs.	.170
23	187.1 lbs.	.830	.443	6.454 lbs.	.128
24	166.9 lbs.	.951	.569	6.844 lbs.	.138
31	162.9 lbs.	.927	.569	5.863 lbs.	.158
Average	159.38 lbs.	.9411	.5985	6.343 lbs.	.1487

TABLE 2.—LOT 2.

NO ROOTS.

Averages for four weeks.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
13	200.2 lbs.	$1.036	$0.517	8.611 lbs.	$0.120
17	156.4 lbs.	.894	.571	7.812 lbs.	.114
20	134.1 lbs.	.972	.724	5.363 lbs.	.181
22	181.2 lbs.	.951	.524	6.659 lbs.	.142
25	185.8 lbs.	1.015	.546	6.741 lbs.	.150
27	166.4 lbs.	.957	.575	5.955 lbs.	.160
28	186.5 lbs.	1.019	.546	6.855 lbs.	.148
32	120.9 lbs.	.868	.717	5.240 lbs.	.165
Average	166.43 lbs.	$0.964	$0.590	6.654 lbs.	$0.1475

ROOTS.

Averages for two weeks.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
13	199.9 lbs.	$1.203	$0.601	8.997 lbs.	$0.133
17	152.6 lbs.	1.031	.675	7.630 lbs.	.135
20	133.2 lbs.	1.111	.834	5.593 lbs.	.198
22	170.7 lbs.	1.067	.625	6.488 lbs.	.164
25	192.1 lbs.	1.146	.596	7.204 lbs.	.159
27	172.2 lbs.	1.071	.621	6.120 lbs.	.175
28	191.6 lbs.	1.137	.593	6.994 lbs.	.162
32	125.2 lbs.	.961	.767	5.136 lbs.	.187
Average	167.18 lbs.	$1.090	$0.664	6.770 lbs.	$0.1641

A study of Table 1 shows a considerable decrease in production, when the roots were dropped out of the rations, which could hardly be entirely due to the advance in the period of lactation. The average weekly production of milk was 10.94 lbs. greater, and of butter fat .457 lb. greater on the root ration. The average weekly cost of the ration, however, was increased by 9.8 cents. The cost of production per cwt. of milk was 2.6 cents greater, and per pound of butter fat .5 cent greater on the root ration.

Table 2 shows a slight increase both in milk and butter fat production, amounting to .75 lb. milk and .116 lb. butter fat, while without the addition of the roots we would expect a decrease because of the advance in the lactation period. The cost of the ration increased with roots 12.6 cents per week, milk cost 7.4 cents more per cwt. and butter fat 1.66 cents more per lb.

TABLE 3.

Average for both lots with and without roots.

Lots 1 and 2.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
With roots	168.75 lbs.	$1.064	$0.6443	6.785 lbs.	$0.1589
Without roots	162.90 lbs.	.952	.5942	6.498 lbs.	.1481
Difference	5.85 lbs.	$0.112	$0.0501	.287 lbs.	$0.0108

In Table 3 the results were averaged from the sixteen cows, while on the "root ration," against the same sixteen when fed without roots. Here it may be seen that both the milk and butter fat were increased by the addition of roots, but the added cost was great enough to render it unprofitable feeding, the average cost of production being 5 cents greater per 100 lbs. of milk and 1.12 cents greater per pound of butter fat.

FEEDING TRIAL—NUMBER TWO.

In the spring of 1906 fourteen cows from the Grade Herd No. 1 were selected in the same manner as in the previous trial and divided into two lots of seven each. The feeding, care and treatment previous to this experiment had been the same. The experiment covered two periods of four weeks each. Four days were taken at the start to get Lot 1 on the root ration, and four days to get Lot 2 on the root ration at the beginning of the second period. During the first period Lot 1 received in addition to the regular herd ration of silage, clover hay, and grain, 20 lbs. per head daily of sliced roots. During the second period the roots were placed in the ration of Lot 2, and Lot 1 received none. The roots were fed twice daily, 10 lbs. at the morning and 10 lbs. at the evening feed. Grain Mixture No. 5 was replaced by Grain Mixture No. 4 during the latter part of the test. About the middle of the last period the silage supply became exhausted, and beet pulp, thoroughly moistened, was substituted in its place. The dried beet pulp used for this purpose was soaked several hours. Feeding the moistened pulp increased the milk flow very markedly, but as it was fed in equal amounts to both lots the accuracy of the results need not be affected.

Lot 1 consisted of cows Nos. 12, 18, 23, 24, 25, 28, 32. Lot 2, cows Nos. 11, 13, 19, 20, 26, 27 and 31.

AVERAGE DAILY RATIONS CONSUMED.

Lot No. 1.

	First Period.	Second Period.
Silage	31.8 lbs.	13.4 lbs.
Pulp	....	5.8 lbs.
Hay	4.2 lbs.	5.35 lbs.
Grain	8.1 lbs.	8.0 lbs.
Roots	20.0 lbs.	....

Lot 2.

	First Period.	Second Period.
Silage	31.5 lbs.	12.8 lbs.
Pulp	....	5.8 lbs.
Hay	4.2 lbs.	5.35 lbs.
Grain	8.5 lbs.	7.9 lbs.
Roots	....	20.0 lbs.

Taking an average of the rations consumed by Lots 1 and 2 while on roots as against Lots 1 and 2 while receiving no roots, we find the rations were almost exactly the same, aside from the roots.

AVERAGE RATION FOR BOTH LOTS.

	Lots 1 and 2 With Roots.	Lots 1 and 2 Without Roots.
Silage	22.3 lbs.	22.4 lbs.
Pulp	2.9 lbs.	2.9 lbs.
Hay	4.8 lbs.	4.8 lbs.
Grain	8.0 lbs.	8.2 lbs.
Roots	20.0 lbs.	....

Tables 4 and 5 give the average weekly milk production, cost of ration, cost of milk per 100 lbs., average weekly butter fat production and cost per pound for all cows in both lots during the entire test.

TABLE 4.—LOT 1.

ROOTS.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
12	156.8 lbs.	$0.961	$0.612	6.463 lbs.	$0.148
18	194.1 lbs.	1.171	.603	6.701 lbs.	.174
23	177.8 lbs.	1.118	.628	7.142 lbs.	.156
24	162.6 lbs.	1.118	.687	7.356 lbs.	.151
25	151.7 lbs.	.925	.609	5.424 lbs.	.170
28	131.4 lbs.	.925	.703	5.028 lbs.	.183
32	156.1 lbs.	1.052	.673	5.702 lbs.	.184
Average	161.5 lbs.	$1.038	$0.645	6.259 lbs.	$0.1665

NO ROOTS.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
12	160.1 lbs.	$1.061	$0.662	6.054 lbs.	$0.175
18	204.4 lbs.	1.143	.559	6.897 lbs.	.165
23	174.2 lbs.	1.133	.650	6.867 lbs.	.164
24	170.3 lbs.	1.109	.651	6.465 lbs.	.171
25	150.0 lbs.	.960	.640	5.104 lbs.	.188
28	128.6 lbs.	.960	.746	4.567 lbs.	.210
32	150.5 lbs.	1.090	.724	5.428 lbs.	.200
Average	162.5 lbs.	$1.065	$0.661	5.911 lbs.	$0.1818

TABLE 5.—LOT 2.

NO ROOTS.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
11	161.2 lbs.	$0.978	$0.606	5.682 lbs.	$0.172
13	149.6 lbs.	.972	.649	6.814 lbs.	.142
19	107.4 lbs.	.785	.731	4.898 lbs.	.160
20	134.8 lbs.	.930	.689	5.323 lbs.	.174
26	137.4 lbs.	.930	.676	5.192 lbs.	.179
27	147.8 lbs.	.918	.621	5.272 lbs.	.174
31	159.1 lbs.	.930	.584	5.966 lbs.	.155
Average	142.4 lbs.	$0.920	$0.6508	5.592 lbs.	$0.1651

ROOTS.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
11	180.7 lbs.	$1.279	$0.708	6.583 lbs.	$0.194
13	184.4 lbs.	1.226	.664	7.494 lbs.	.163
19	132.0 lbs.	1.099	.832	5.394 lbs.	.203
20	157.9 lbs.	1.230	.778	5.677 lbs.	.216
26	159.4 lbs.	1.230	.771	5.343 lbs.	.232
27	165.1 lbs.	1.053	.637	5.946 lbs.	.177
31	174.9 lbs.	1.247	.712	6.057 lbs.	.205
Average	164.9 lbs.	$1.194	$0.7288	6.070 lbs.	$0.1985

The addition of the moistened beet pulp to the ration during the latter period with Lot 1, when no roots were fed, seems to have kept the production, both in milk and butter fat, on a level with the first period, when roots were fed, but raised the cost of ration and the cost of production. With Lot 2 the beet pulp was fed in the same period with the roots, so that while the two stimulated both milk and butter fat production to a considerable degree beyond that of the first period, still the cost of the ration and of milk and butter fat was increased very materially. A fair way of comparison here would be to average together the periods when each lot was fed roots against the periods when they received no roots in the ration. This would eliminate the beet pulp factor, both sides having received equal amounts.

TABLE 6.

Table showing average production of Lots 1 and 2 on Root Ration vs. Ration Without Roots.

Lots 1 and 2.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
Roots	163.20 lbs.	$1.116	$0.6869	6.164 lbs.	$0.1825
No roots	152.45 lbs.	.992	.6559	5.751 lbs.	.1734
Difference	10.75 lbs.	$0.124	$0.0310	.413 lbs.	$0.0091

This table shows, on an average taken from fourteen cows in two four-weeks feeding periods, that the addition of twenty pounds of roots to the daily ration increased the milk production 10.75 lbs. per week, and the butter fat production .413 lb. per week, but the cost of the ration was increased 12.4 cents per week; the cost of 100 lbs. milk increased 3.1 cents, and butter fat cost 0.91 cent more per pound than on the ration containing no roots.

WEIGHTS.

Average weight 14 cows at start of root ration	985.5 lbs.
Average weight 14 cows at close of root ration	993.2 lbs.
Average gain per cow in four weeks on roots	7.7 lbs.
Average weight 14 cows at start of ration without roots	1006.0 lbs.
Average weight 14 cows at close of ration without roots	975.3 lbs.
Avg. loss per cow in four weeks on ration without roots	30.7 lbs.

The root ration, therefore, seemed to keep the cows in somewhat better condition of flesh, as a considerable loss in weight followed the removal of roots from the ration.

FEEDING TRIAL—NUMBER THREE.

This was carried out in the spring of 1906 with two lots of five cows each, selected from Grade Herd No. 2. As in the two experiments reported above, precautions were taken to divide the lots as evenly as possible from previous production and period of lactation. All ten cows had been on the same feed up to the beginning of the test, namely, silage, clover hay, and grain, and were continued on the same ration throughout the experiment, except for the addition of 20 lbs. of roots per head daily to Lot 1 during the first four weeks, and the same to Lot 2 during the second period of four weeks.

The roots were fed twice daily, 10 lbs. at a feed.

Lot 1 consisted of Nos. 11, 12, 13, 14, 16, and Lot 2 of Nos. 15, 17, 18, 19 and 20.

The average rations consumed per head daily for the two lots follow:

Lot 1.

	First Period.	Second Period.
Silage	24. lbs.	25.2 lbs.
Hay	6.8 lbs.	6.0 lbs.
Grain	8.5 lbs.	8.5 lbs.
Roots	20.0 lbs.	....

Lot. 2.

	First Period.	Second Period.
Silage	25.5 lbs.	25.3 lbs.
Hay	6.8 lbs.	6.0 lbs.
Grain	8.8 lbs.	8.8 lbs.
Roots	....	20.0 lbs.

Taking an average of the rations consumed by both lots on roots, as against both lots without roots, and the difference aside from the presence or absence of roots is so small that it would have practically no bearing upon the results.

AVERAGE RATION FOR BOTH LOTS.

	Lots 1 and 2. Ration with roots.	Lots 1 and 2. Ration without roots.
Silage	24.65 lbs.	25.35 lbs.
Hay	6.4 lbs.	6.4 lbs.
Grain	8.65 lbs.	8.65 lbs.
Roots	20.00 lbs.	....

Tables 7 and 8 show the average weekly milk and butter fat production, average weekly cost of ration, and cost of milk and butter fat.

TABLE 7.—LOT 1.

ROOTS.

First period, four weeks.

Number of cow	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
11........................	141.9 lbs.	$1.093	$0.7702	5.605 lbs.	$0.1950
12........................	178.8 lbs.	1.093	.6113	6.879 lbs.	.1589
13........................	159.2 lbs.	1.093	.6867	5.489 lbs.	.1991
14........................	213.3 lbs.	1.197	.5611	8.586 lbs.	.1394
16........................	149.3 lbs.	.989	.6629	6.045 lbs.	.1637
Average................	168.5 lbs.	$1.093	$0.6584	6.520 lbs.	$0.1712

NO ROOTS.

Second period, four weeks.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
11........................	131.5 lbs.	$0.950	$0.722	5.261 lbs.	$0.180
12........................	168.6 lbs.	.950	.563	6.496 lbs.	.146
13........................	148.9 lbs.	.950	.638	5.657 lbs.	.167
14........................	173.9 lbs.	1.020	.586	7.430 lbs.	.137
16........................	133.7 lbs.	.845	.632	5.582 lbs.	.151
Average................	151.3 lbs.	$0.943	$0.628	6.085 lbs.	$0.156

Table 7 shows a weekly increase of 17.2 lbs. in milk and .435 lb. in butter fat production when on root ration, but at an increased cost of 3.0 cents per 100 lbs. of milk, and 1.5 cents per pound of butter fat, because of the extra cost of the ration amounting to 15.0 cents per week.

TABLE 8.—LOT 2.

NO ROOTS.

First period, four weeks.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat
15	143.7 lbs.	$0.965	$0.671	5.895 lbs.	$0.163
17	188.0 lbs.	1.071	.569	7.003 lbs.	.151
18	173.2 lbs.	.967	.558	6.409 lbs.	.150
19	149.2 lbs.	.967	.648	5.520 lbs.	.175
20	155.6 lbs.	.967	.621	6.610 lbs.	.146
Average	161.9 lbs.	$0.987	$0.613	6.287 lbs.	$0.157

ROOTS.

Second period, four weeks.

Number of cow.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
15	153.0 lbs.	$1.090	$0.712	5.967 lbs.	$0.182
17	197.9 lbs.	1.194	.603	7.568 lbs.	.157
18	175.0 lbs.	1.090	.622	6.607 lbs.	.164
19	143.7 lbs.	1.090	.758	5.499 lbs.	.198
20	163.4 lbs.	1.090	.667	6.940 lbs.	.157
Average	166.6 lbs.	$1.110	$0.672	6.516 lbs.	$0.171

Table 8 shows an increase of 4.7 lbs. in milk and of .229 lb. in butter fat production when Lot 2 was fed the ration containing roots, but this larger production was attended with an increased cost, milk costing 5.9 cents more per cwt. and butter fat 1.4 cents more per pound on the root feed.

TABLE 9.

Table showing averages of results from Lots 1 and 2 on Root Ration, as against ration without roots.

Lots 1 and 2.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
Roots	167.5 lbs.	$1.101	$0.665	6.518 lbs.	$0.171
No roots	156.6 lbs.	.965	.620	6.186 lbs.	.156
Difference	10.9 lbs.	$0.136	$0.045	.332 lbs.	$0.015

The average from the ten cows in two four-weeks feeding periods shows an increased production of 10.9 lbs. in milk per week, and .332 lb. in butter fat per week on the root ration; this ration, however, costing on an average 13.6 cents more per week. The cost of milk was increased 4.5 cents per cwt., and butter fat 1.5 cents per pound on the root ration.

WEIGHTS.

Average weight of 10 cows at start of root ration..........	991.3 lbs.
Average weight of 10 cows at close of root ration...........	1005.7 lbs
Average gain per cow in 4 weeks on root ration........	14.4 lbs.
Average weight of 10 cows at start of ration without roots..	997.2 lbs.
Average weight of 10 cows at close of ration without roots..	1003.1 lbs.
Average gain per cow in 4 weeks on ration without roots	5.9 lbs.

In this case the cows gained without roots as well as with roots, though increase was slightly larger on the root ration.

TABLE 10.

Summary of results of three experiments with 40 cows.

ROOTS.

	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
Experiment 1, 16 cows.......	168.7 lbs.	$1.064	$0.644	6.785 lbs.	$0.158
Experiment 2, 14 cows......	163.2 lbs.	1.116	.686	6.164 lbs.	.182
Experiment 3, 10 cows.......	167.5 lbs.	1.101	.665	6.518 lbs.	.171
Average for 40 cows......	166.4 lbs.	$1.093	$0.665	6.489 lbs.	$0.170

NO ROOTS.

	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
Experiment 1, 16 cows.......	162.9 lbs.	$0.952	$0.594	6.498 lbs.	$0.148
Experiment 2, 14 cows.......	152.4 lbs.	.992	.655	5.751 lbs.	.173
Experiment 3, 10 cows.......	156.6 lbs.	.965	.620	6.186 lbs.	.156
Average for 40 cows......	157 .3 lbs.	$0.969	$0.623	6.145 lbs.	$0.159

TABLE 11.

Comparison of results from Table 10.

Average for 40 cows.	Average weekly milk production.	Average weekly cost of ration.	Average cost of milk per cwt.	Av. weekly butter fat production.	Average cost per lb. butter fat.
Roots......................	166.4 lbs.	$1.093	$0.665	6.489 lbs.	$0.170
No roots....................	157.3 lbs.	.969	.623	6.145 lbs.	.159
Difference...............	9.1 lbs.	$0.124	$0.042	.344 lbs.	$0.011

Average per cent butter fat, "Roots," 3.89.
Average per cent butter fat, "No Roots," 3.90.
The per cent of butter fat was practically the same.

The last table gives the average weekly milk and butter fat production, the average weekly cost of the rations, and the average cost of milk and butter fat as taken from the three feeding trials with a total number of forty cows. The table shows that, while on the root ration the cows produced 9.1 lbs of milk per week, or 1.3 lbs. per day more than when receiving no roots, that the butter fat production was increased by .344 lbs. per week, or .049 lbs. per day. The addition of roots, however, increased the cost of the ration by 12.4 cents per week, or 1.77 cents per day, and the cost of milk production on the root ration was raised 4.2 cents per 100 lbs., of butter fat 1.1 cents per pound.

SUMMARY.

Increase in weekly milk flow per cow on root ration:

Experiment 1	5.85 lbs.
Experiment 2	10.75 lbs.
Experiment 3	10.90 lbs.
Average	9.16 lbs.

Increase in weekly butter fat production, per cow, on root ration.

Experiment 1	.287 lbs.
Experiment 2	.413 lbs.
Experiment 3	.332 lbs.
Average	.344 lbs.

Increase in cost of ration per cow for one week, roots added:

Experiment 1	11.2 cents
Experiment 2	12.4 cents
Experiment 3	13.6 cents
Average	12.4 cents

Increase in cost of milk per 100 lbs, when on root ration:

Experiment 1	5.01 cents
Experiment 2	3.10 cents
Experiment 3	4.50 cents
Average	4.20 cents

Increase in cost of butter fat per pound, on root ration:

Experiment 1	1.08 cents
Experiment 2	0.91 cents
Experiment 3	1.50 cents
Average	1.16 cents

CONCLUSIONS.

The addition of roots to an already complete ration of silage, clover hay, and grain, for a dairy cow, stimulated both milk and butter fat production.

The cost of the ration, however, was raised to such a degree as to lessen the profit of production, milk costing 4.2 cents more per hundred pounds, and butter fat 1.1 cents more per pound, as a result.

In case a large production is desired, as in making records, roots might be used to advantage.

The cows gained in weight more on the root ration, than when fed without roots, but the difference was not great.

The percentage of butter fat in the milk was constant, whether on the "Root Ration," or without roots.

A PLAN FOR THE IMPROVEMENT OF MICHIGAN CATTLE.

R. S. SHAW.

Bulletin No. 241.

The presentation of this publication, at the present time, is designed to serve a two-fold purpose. First, it is intended to be preliminary to reports of animal breeding experiments of an important practical nature either now in progress at this institution, or about to be taken up. Some of this work has been under way for more than eighteen months, and many more months and several years, even, must needs elapse before other phases can be completed and reported. These investigations are being pursued with the idea of securing more definite data relating to some of the problems hereinafter discussed. In the second place, it is hoped that the following discussion may lead to the adoption of better methods in some of the commoner practices of animal breeding, the principles of which are frequently grossly violated, quite as often through carelessness and indifference as through a lack of knowledge of them. While the illustrations and references relate chiefly to cattle, many of the practices advocated will apply equally well to the breeding of other classes of farm animals.

NUMBERS OF CATTLE IN MICHIGAN.

According to the 12th census of the United States there were June 1, 1900, 1,425,700 cattle in the State of Michigan, on farms, ranges, and in barns and inclosures. In other words, this number includes cattle on farms and in villages, towns and cities. On the basis of comparative numbers of cattle, according to this census, Michigan stood eighteenth among the states and territories of the Union.

From the last state census report we find that on July 1, 1904, Michigan possessed the following numbers of cattle, viz.:

	Head.	Value.	Average value.
Calves under 1 year..............	425,369	$2,462,105.00	$5.78
Steers 1 year and under 2 years..	190,791	2,723,265.00	14.27
Steers 2 years and under 3 years..	83,688	2,055,051.00	24.55
Steers 3 years and over...........	9,187	319,553.00	34.78
Bulls 1 year and over............	27,880	805,932.00	28.90
Heifers 1 year and under 2 years.	194,688	2,947,460.00	15.13
Dairy cows 2 years and over......	746,685	23,351,723.00	31.27
Other cows 2 years and over.......	66,222	1,709,788.00	25.82
Total......................	1,744,510	$36,374,877.00	

Though Michigan now ranks eighteenth among the states and territories in numbers of live stock, it is not expected that she will ever rank among the first, because of the great diversity of her interests, such as agriculture, horticulture, lumbering, mining, manufacturing, marine, etc. That state possessed of the greatest live stock valuations is a strictly agricultural state, and probably possesses a higher per cent of tillable land than any other, while Michigan possesses a large area of nontillable land. We do not need greater numbers of cattle so much as we need better ones.

A GLIMPSE AT SOME PRECEDING CONDITIONS.

Some interesting features are presented in a brief review of the history of the development of the live stock industry in Michigan. It has not been rapid as in some of the states to the westward which went into the live stock business a few decades later, and which have now far outstripped us as regards numbers of cattle. But the natural conditions, as the pioneer found them in Michigan, were not suited to the rapid development of the stock business. He had to produce the proper conditions. The first settlers found nearly all the surface of Michigan covered with heavy timber. As in all forest regions, the forage of Michigan was scant in quantity, and lacking in nutrition for live stock. The coarse herbage which grew in the marshes and along the lake borders was little or no better than that which grew under the trees. The land had to be cleared before forage and fodder crops could be produced. As in all timbered sections, the settler had no desire to own more cattle than were required to supply the immediate needs of his family; he was loth to feed to live stock the cereals which were produced on lands requiring so much labor in the clearing and cultivation. On the other hand, the prairies of the states to the south and westward, covered with an abundance of nutritious pasturage, awaited the coming of the plow of the pioneer, and immediately produced an abundance of grain and forage to supplement the rich natural pastures, thereby making possible the rapid development of the live stock industry. During the earlier history of this state the energies of the farmer were diverted to other lines of work than live stock production. In general, we find in the history of any new country, that far more attention is given to crop production, for a long interval, than to animal production. This has been particularly true of the eastern and central states, while the reverse was true of the far west. The pioneer brought with him a very limited live stock equipment, consisting of work horses or oxen, one or more cows to furnish milk and butter for the family, and a few pigs to furnish a large portion of the year's supply of meat. The first business of the pioneer was to unlock the rich storehouse of fertility found in the virgin soil. The doors of this storehouse were exceedingly ponderous, consisting as they did of oak, maple, beech, elm or pine, according to the conditions, firmly imbedded in the soil by tenacious roots. The finances of the pioneer were such that he must needs produce cash crops to supply his pressing needs and add better facilities to his meagre equipment. The rich virgin soil responded freely at first, yielding prolific crops of a variety of cereals possessed of high commercial value. Finally, however, the land became less and less productive; each suc-

ceeding year the crops of corn, wheat, oats and barley became smaller. The keen competition of newer western fields decreased crop values, while on the other hand, smuts, rusts, blights and insect pests of various kinds began to appear, materially affecting both the quantity and quality of the crops produced. These conditions demanded the keeping of more live stock on the farms in order to enrich them and utilize to better advantage those crops low in commercial value in the raw state; they had to be manufactured into meat, milk, wool and work, and thus many were led into some line of animal production. These statements, of course, do not apply to the small minority who introduced and bred improved live stock from an early date.

MICHIGAN CONDITIONS ARE NOW WELL SUITED TO THE LIVE STOCK INDUSTRY.

A large area of the state has long been cleared and prepared for the production of crops well suited to the growth of live stock. The climatic conditions are not extreme; the cold is not prolonged and severe in winter, except in the extreme north, and the same is true of the heat in summer. The precipitation is sufficiently large and uniformly distributed to render the production of forage, fodder, soiling crops and pastures a certainty. Our lands are well interspersed with living streams and lakes, furnishing excellent water. Michigan is the home of corn and clover and because of the ease with which an abundance of the latter can be produced, our chances to compete with the producers of the corn belt are more than evened up. Good transportation facilities have been afforded every part of the state by the ramification of a great network of railroads. We have easy access to the best eastern and western markets, in addition to a large and ever increasing home demand. The heavy wave of keen western competition which has pinched the Michigan stockman in the past, has undoubtedly reached its maximum height, and the future prosperity of our stockmen would seem assured, providing the various divisions of the industry are developed in accord with the conditions and demands. Since nature has given the state good climatic conditions, and the artifices of man have produced the other essential conditions, there is no reason why the live stock industry of the state should not grow, improve and prosper.

THE TWO CLASSES ENGAGED IN THE LIVE STOCK INDUSTRY TODAY.

For the purpose of the discussion that is to follow, we shall divide the producers of Michigan cattle into two classes. First, there is that class comprising the small minority engaged largely in the production of pedigreed animals to be offered for sale for purposes of improvement; we have no criticism or suggestion to offer this class. They are by far too few and do not receive the support and encouragement their efforts deserve. The last three volumes of each of the various registry associations include the names of less than 1,500 Michigan cattle breeders. There are a few who undoubtedly own pure bred animals, but have not been keeping the registration up. On the other hand this list must include some who own but a single recorded animal, namely a bull. The fact that these men own recorded stock is evidence

enough that they are interested in live stock improvement, and are familiar with, and are practicing good methods of live stock breeding.

The second class, comprising by far the great majority, is the one in whose hands the inferior stocks are to be found. Because this last class comprises such an overwhelming majority of stock owners, and because it produces nearly all the animals and animal products marketed, its influence in determining the character and reputation of Michigan meat and milk products is very far reaching. It is in the hands of some of this class that the scrub and animal of badly mixed breeding are to be found. After the few breeders of pure bred animals have expended large sums of money for good foundation stocks, and offered good young pure bred males at moderate prices, it cannot be denied that they are extremely slow of sale in Michigan. The ordinary producer of meats and milk (not breeder), seems determined not to pay more than about meat prices for males to infuse improved blood in his herd, and the breeder cannot make a living producing them at such prices. Failing to secure improved males at these low prices, many producers fall back on the grade or even the scrub, and frequently combine with this in-breeding, especially where the males are chosen within the herd. The greatest, and most pressing needs of today, in live stock improvement, are more breeders, more good males, and more men willing to pay remunerative prices for them, and cease admixing blood, and using grade and scrub sires.

INFERIORITY OF THE COMMON STOCKS.

The chief fault of the common cattle found in Michigan today, is their lack of quality and uniformity; this is not due so much to the lack of infusion of good blood, as to the indiscriminate admixture of the blood of breeds of both beef and dairy types. It is not necessary for us to attempt to present and establish proof of this assertion, as every live stock producer can secure abundant evidence for himself in a short time, by simply exercising the faculty of observation. In traveling about the state by wagon road or rail, note the number of animals in each herd seen, also the variation in type, form, and more particularly, color. Except for the herds of the few growers of pure bred, or high grade cattle, the common bunches will be found to include a great variety of color and types. In some herds red, white, black, brindle, and all conceivable combinations of these colors are to be found; at the same time some individuals will conform in a measure to strictly beef form, others quite markedly to dairy form, with all gradations between these two. The indications of blood, as seen in color, will undoubtedly attract the attention of the casual observer more readily than other features. In other words, the presence and admixture of so many colors in common herds indicates that Shorthorn, Holstein, Jersey and less frequently Hereford and Ayrshire blood has been freely admixed in the state. The seriousness of this lack of uniformity in breeding, quality, color, form, etc., is not fully appreciated. For the past ten or twelve years, with one or two exceptions, the Chicago market has been topped by a certain breed of cattle sold in car load lots. The reasons for this are found in the word uniformity. They have been uniform in size, color, form, finish, and quality; in

fact, as much alike as so many peas; you see one and you see them all. This prime requisite of uniformity can never be secured through mixed breeding. The man who offers for sale nineteen good steers and one inferior one bearing undesirable color, is at a great disadvantage; the scrub steer is ever under the nose of the prospective purchaser, and offers him a strong pretext for lowering his bid.

A large percentage of the best cattle fed in Michigan today, by good feeders, are secured from without the state, at western stockyards; the feeders of these cattle claim that it is difficult to secure feeding cattle of good quality and uniformity at home; one has to purchase the culls along with the good ones in order to get any. Close inspection of consignments of cattle from this state is not necessary to convince one of their lack of breeding; the drover who picks up a few market cattle here and there, until a load or two is made up for shipment, is the man who gathers together the motley combination representing the large aggregate; the man who breeds, buys and feeds a good car or more of steers usually markets them himself.

SOME CAUSES OF LACK OF BREEDING IN MICHIGAN CATTLE.

The indiscriminate admixture of the blood of the various breeds has been one of the most direct causes of the production of inferior stocks. This has not been restricted to the breeds within the beef and dairy classes, but includes admixture of the blood of the two classes. With the rise in prices of dairy products, the common cows have been bred to dairy bulls; with depreciated values for dairy products, these same cows and their female progeny have been bred back to beef sires, and so on. On the other hand, there are plenty of instances where herds possessed of cows of a small type, producing a small flow of rich milk, have been bred to a bull of a larger breed noted for heavy milk flow, and vice versa. There are too many animals in our yards today saved from bulls bred to females for no other purpose than to "freshen them again."

The lack of good breeding among our cattle today is not due to lack of introduction of good blood at an early date. Shorthorns were brought into Michigan in 1843, Galloways in 1854, Herefords in 1864, and Aberdeen Angus in 1884. Holsteins and Jerseys were also introduced at comparatively early dates. The records of Michigan fair associations, from the time of the organization of the State Fair in 1849, would seem to indicate that unusual activity in pedigreed live stock breeding was manifested in the earlier days but this seems to have been confined to the so-called breeders.

In the report of Edward W. Perry, of the Bureau of Animal Industry, to Hon. N. G. Coleman, Commissioner of Agriculture, in 1887, the statement is made to the effect that in 1884, only 138,500 head, or 19 per cent of the cattle of Michigan at that time, possessed blood of improved or pure bred animals.

Another potent force tending toward the production of inferior cattle in this state is found in the too prevalent use of grade and scrub bulls. According to the last state census there were 27,800 bulls one year and over in Michigan in 1904, valued at $805,932.00, or an average of $28.90 each. This same report gives the number of three-year old steers in

Michigan on that date at 9,187 head, valued at $319,553.00, averaging $34.78 per head. Breeders of Michigan, stop and think what this means, 27,880 bulls one year and over in this state July 1, 1904, with an average value of $28.90! Bulls worth less per head than three-year old steers by $5.88 per head. There are many other states in exactly this same position regarding the relative values of bulls and three-year old steers, but none of them are justified in it.

LIVE STOCK IMPROVEMENT NOT DIFFICULT.

Questions of breeding are generally regarded as being obscure, intricate and extremely difficult, except to those skilled in the art through long years of training. It is true that we are obliged to look back upon the achievements of the "master breeders" of history with feelings akin to reverence, for their tasks of type founding, breed forming and breed improvement were difficult, requiring a whole lifetime in some instances to gain the mastery, and in others two whole generations to attain the highest success. But the initial step in live stock breeding for improvement confronting us today, is an exceedingly simple one; we do not need to undertake the establishment of new types or breeds, as there are plenty now in existence to choose from, which, judiciously chosen will respond favorably to the conditions to which they are adapted. The first step in the line of live stock improvement must come from the cessation of the practice of admixing the blood of the various breeds, and of using grade and scrub sires.

PLAN FOR LIVE STOCK IMPROVEMENT.

Before introducing the plan of live stock improvement, known as up-grading, we wish to state that it should be the ambition of every man owning live stock to eventually get into some line of pure-bred live stock breeding. The plan we have to suggest and discuss for the improvement of the common stocks of the country, is that known as up-grading, which consists in ingrafting the characteristics of a superior bred upon animals of common, or mixed breding for the purpose of improving them. This improvement is due to the superior quality of the males used, and chiefly their prepotency, or power of transmitting accurately these qualities to their offspring. This plan differs from cross breeding, in that pure blood is used on the sire's side, and females of mixed blood, or no blood, on the dam's side. Thus we have the prepotency concentrated in the bull, and the very opposite in the females, as the more mixed the breeding, the less stable are the inherent characteristics of the individual, and therefore the less resistant to improvement. It would be absolutely impractical to advise all owners of common cattle to send their stocks to the block and purchase pure bred foundation stocks; only a few could do this for the following reasons: First, if the great majority now possessed of common stocks were to simultaneously seek to purchase pure bred foundation stocks, they could not get them, they are not in existence, for only about one per cent of the cattle in the United States are possessed of pedigrees. Second, the finances of a great many holders of common stock are not such as to allow them to make extensive purchases of pedigreed animals,

and replacement is out of the question, as it would require the returns from the sale of three or four common animals to purchase one pedigreed one. Third, it is highly desirable for breeders to grow into any line of pure breeding rather than to buy into it suddenly, and take up a work in which experience is necessary.

In general, then, it is necessary for the majority of holders of common stock to make the best use of the animals on hand, with a view to improving them. Let us suppose the case of a herd of common, or mixed cattle of say eighteen head, and apply a plan of improvement. The first thing for the owner of this herd to do, is to decide upon some one line of production, either beef or dairy, and then stand by the resolution. Without this he cannot improve his herd, for the animals of mixed breeding are largely the result of frequent change of purpose. Suppose in this case, that the owner has decided to go into the dairy business; that being the case, the next thing to do will be to look over the herd of eighteen, and decide which ones are so possessed of dairy type and characteristics, as to warrant their being used in the business. They can be divided into three classes, such as best, medium and inferior, from a dairy standpoint. Then, in the majority of cases, it will be found to be a decided advantage to send the six inferior ones to the block and use the remaining twelve for the foundation herd. Having selected the females to be retained, the next and one of the most important steps is to decide upon the breed to be used in improvement. In this, adaptability of the breed to the conditions, and the question of personal preference, are the two important factors; the decision of this question is also an important factor, for a change of mind after the work has begun, and the use of other blood, is more apt to result in retrogression for a time, than improvement. Having decided upon the breed to be used for improvement, suppose it is the Holstein, then purchase the best Holstein bull that the pocket book will allow. Mate this bull with the twelve selected cows, and use him for two seasons, after which his progeny will be old enough to breed. At this point secure another Holstein bull, a better one than the first if possible; follow him with others of the same breed, indefinitely. Let it be Holstein bull after Holstein bull, nothing but Holstein bulls. We have cited the Holstein merely for the purpose of this illustration. The same plan must be used, no matter what the breed is.

We may expect, after a few top-crosses in upgrading, that the progeny will resemble the type of the sires used in improvement, quite closely, both as to form and general characteristics; in fact, so much so that the high grade may eventually equal the pure blood improver from a standpoint of utility in meat or milk making, as the case may be. There is some question as to the number of crosses that must be produced before this high standard of excellence will be secured in the grade. This will be somewhat dependent on the duration of the purity of the improving blood, the prepotency of the individual sires, and the plasticity of the common females. Instances are on record where ideal high grades have resulted from the third cross; in general, one would be safe in counting on at least the fifth. We must not, however, lose sight of of the fact that while a high grade may eventually equal the improving breed from a standpoint of meat or milk making, that it can never be

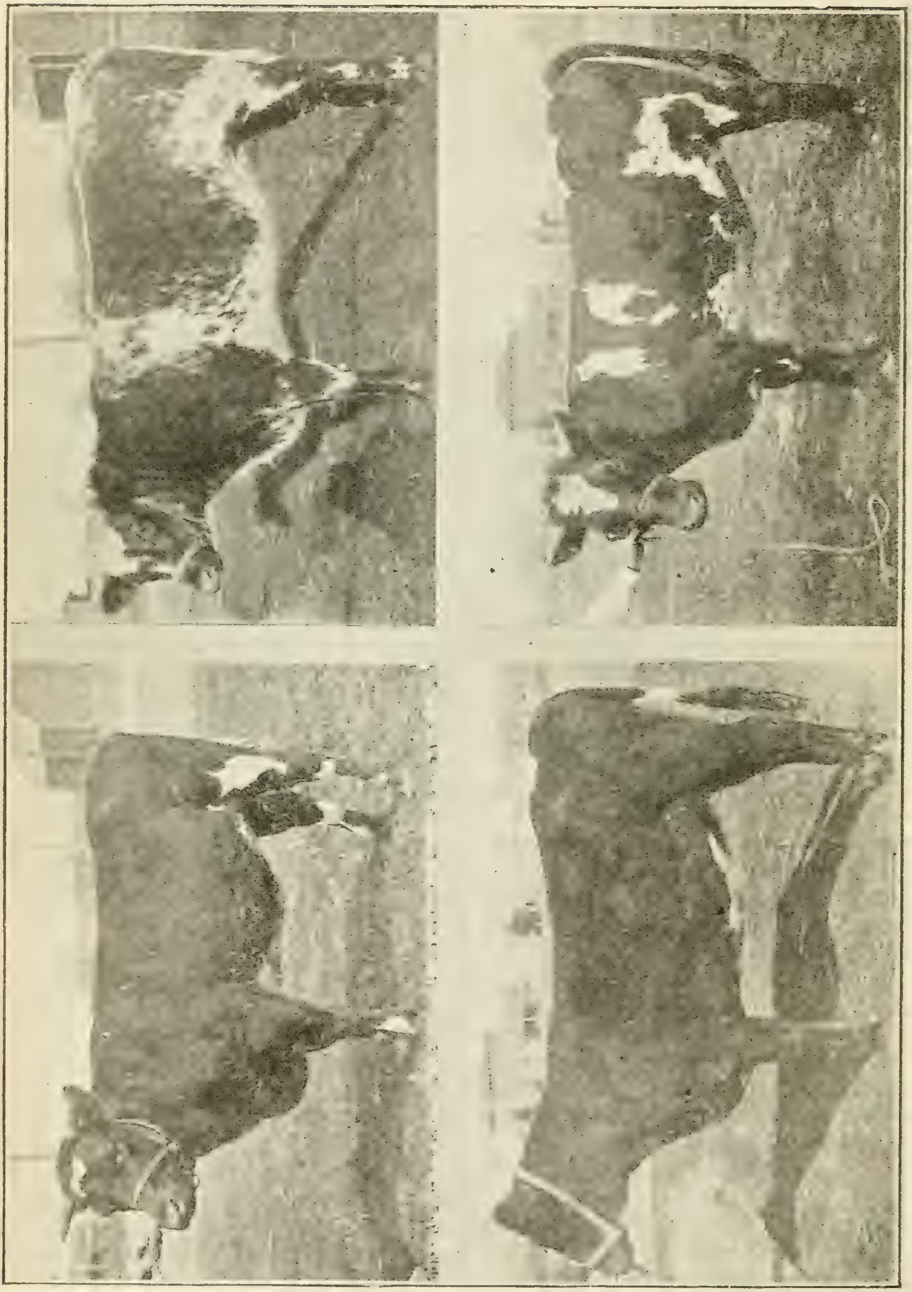


ILLUSTRATION NO. 1.

possessed of a pedigree, nor equal the full bloods from a standpoint of prepotency in breeding; this is the principal argument used against grade sires.

In illustration No. 1 four yearling females are shown. The two in the upper row are pedigreed Shorthorns bred from college stocks; the one in the upper left hand corner, Sharon Princess, sired by Gwenallen 38892, out of College Sharon, Vol. 49, p. 949; the one in the upper right-hand corner is Mysie's Opal, sired by Gwenallen, and out of College Mysie 5th, Vol. 40, p. 753. The two females in the lower row are simply high grade Shorthorns which are out of Shorthorn grade cows purchased in Tuscola county, Mich., by the Michigan Agricultural College in the fall of 1904; as the cows were in calf at the time of purchase and as the carload was picked up one by one, it was not possible to trace the sires of individual calves. While these two grade heifers illustrate well the possibilities of up-grading, it is unfortunate that the number of generations since their improvement began cannot be determined. We again remind our readers of the statement made in a preceding paragraph relative to the possibilities through upgrading, and leave them to judge for themselves to what extent the illustration bears out our argument.

Breeding experiments are now in progress at this college to determine how many generations must be produced before animals can be secured equal to the improving breed, from a standpoint of utility, but some years must elapse before results can be secured.

We also suggest that at the time of the purchase of the pure bred sire, one cow, or possibly two of the same breed be secured. The progeny of these two or three registered animals should grow into a nice little herd at the end of ten years, which could be used to replace the poorer of the high grades. That the high grade can be successfully produced as described, cannot be disputed, and its values have already been clearly demonstrated. The high grade forms the bulk of the western feeders coming to our feed lots; it makes up almost the sum total of the 400,000 prime steers which annually cross the Atlantic; it has occupied no mean place in the list of awards in fat classes at state, national and international live stock shows.

We desire at this point to emphasize the fact that the use of improved methods of breeding alone will not avail, it is absolutely necessary for these to be supplemented by liberal feeding and proper care and management.

THE GRADE SIRE.

Attention has been directed to the fact that high grade animals may be eventually produced capable of equalling those of the pure breed used in their improvement, insofar as meat or milk production are concerned, but at the same time they can never equal them in prepotency, nor become possessed of pedigrees, except in rare instances. So far as external form and indications of quality are concerned, a high grade sire may look equally as good as a pure bred one, and still this is no justification for his use. Though an animal may be an exceptionally good individual, if he is lacking in prepotency, as the grade derived from mixed blood on the dam's side is sure to be, his offspring cannot

equal those of the pure male. And so in actual practice, except in rare instances, grade sires fail to produce offspring possessed of the marked uniformity and quality of those from the pure bred male. We call attention just here to the fact that the quality of prepotency more markedly manifest in the breeds of most ancient origin has been developed through centuries; we must not expect to develop it in high grades in one decade. It would be useless to say that no grade sires should be used at all, for if 27,800 bulls are needed in Michigan, as indicated by the last state census, only a portion of this number could possibly be made up of pure breds, as they are not to be had. Therefore, the only rational thing to advocate is the utilization of all pure bred bulls to their fullest extent, the use of the fewest possible high grade sires for the present, the use of the best of this class and the replacement of these by pedigreed animals as rapidly as possible. Occasionally, in purchasing, a man hesitates between two sires, the one a grade, the other a pure bred; the former perhaps about as good as the latter in individuality, judging from appearances. On this basis, the purchaser secures the grade because it is at least one-half cheaper, but in considering the final results we should not lose sight of the fact that the superiority of a crop of ten calves from a pure bred sire is almost sure to be so much greater than the same number from a high grade, that the difference in the purchase price of the two sires may be more than made up in a single season.

DISCARDING THE SO-CALLED AGED BULL.

In general, it can scarcely be said of a bull, that he has reached full maturity until four years of age, though this perfect stage of development is commonly regarded as being attained at a somewhat earlier age among some breeds. It has been a common practice, for years, among farmers, to send the three or four years old bulls to the block, largely because there is no sale for them as breeders. The general rule among prospective purchasers is to search for nothing but young bulls, yearlings or less, with the idea that they will grow into money for them, if they can dispose of them before maturity. It is a false economy to purchase on this basis solely and take more or less chance on a young, untried animal when the actual results from a mature animal may be ascertained. There are two principal reasons why sires are usually sent to the block at three or four years of age. First, it is claimed that their dispositions do not mellow with age, and second, they become too large, heavy and clumsy, and it may tend to impotency. In answer to the first of these objections, we believe that except for the inheritance of mean, treacherous dispositions, bulls, in general, return on the points of their horns only that which is dealt out to them on the points of the fork, or in other words, the bull responds to the character of the treatment and management given him. Mature bulls should not have a tendency towards impotency if properly fed, managed and exercised, but because of the fact that the bull is isolated, he is frequently neglected to a greater extent than any other animal on the farm. Too many bulls are fed irregularly and improperly, and confined constantly for long periods in small dark filthy box stalls; these conditions are not conducive to good breeding qualities.

There are some decided advantages in purchasing mature bulls. One of the greatest of these is found in the fact that the buyer can ascertain something relative to the character of their get; this is most important to the breeder of dairy stock. Another advantage arises from the fact that there is always more or less uncertainty regarding the future development of the bull calf, while this factor is entirely eliminated in the purchase of a mature sire. It is also not unreasonable to conclude that a mature sire will beget more vigorous offspring, especially because the young ones are frequently used to excess. Three and four year old bulls can generally be secured at very reasonable prices. Some of the best show cattle we have seen were sired by bulls far past the mature stage. The expert breeder appreciates the value of mature sires. Attention is directed to the Shorthorn bull Gwenallen shown on the front cover page, now ten years old and in active service in the college herd; also Count Colantha Alban, eight years old, illustration No. 4, at the head of the college Hostein herd.

EVIL EFFECTS OF BREEDING IMMATURE FEMALES.

During the past decade or two, there has been a growing tendency to breed heifers at an early age; this is particularly true among the dairy breeds. The men who advocate and practice the breeding of heifers so as to produce calves under or at about twenty months of age, are extremely numerous. In fact, the practice has been carried to such an extreme that in many localities mature cows of some of the dairy breeds cannot be found bearing the same size that these types did twenty years ago. This practice is supported chiefly on the following grounds, viz.: First, that the earlier a heifer is made to produce, the sooner she begins to make some financial return for her keep, and second, the capabilities of the dairy cow can be increased if stimulated at an early age. There are those who claim not to object to lack of size in dairy cows, and also that the smaller cows are more profitable, but this latter claim has not yet been proven. The relative value of small versus large dairy cows as economic producers has not been determined, though much discussed. It is a notable fact, however, that the world's record makers and the majority of the cows entered in the various advanced registry associations, are, in general, considerably above the average as to size. It is also a notable fact that the twenty-five Jersey cows entered in the dairy cow demonstration at St. Louis in 1904, were large cows, the average weight for the twenty-five at the beginning of the test was 911.2 pounds, and at the close 983 pounds. These figures place them considerably above the average of the cows of this breed in general use in many dairy sections today. These cows were used in a test where comparative economic production was one of the main features. Some expert dairy breeders are inclining more and more to the belief that heifers should be allowed greater maturity before dropping the first calves and are also permitting them to lay on more flesh than has been thought to be safe; these men are demonstrating the accuracy of their theories in the results produced. While it is clearly apparent that immature breeding has reduced the size of many of our dairy cattle, it has not been proven that diminished constitutional vigor has accom-

panied this loss of size, though many hold to that view. It is rational to assume that in unduly immature breeding some of the physiological laws of nature must be violated, and this cannot occur without being followed by some evil results. No fixed age can be given for the breeding of heifers, it should be dependent on the rapidity and character of the development of the individual.

Illustration No. 2 represents an Ayrshire cow calved September 20, 1900. By the time this cow was thirty-seven months of age she had produced her second calf. In October, 1903, this cow weighed but 718 pounds, when in about the same condition of flesh as that shown

ILLUSTRATION NO. 2.

in the illustration. Ten or fifteen years ago when dairy cattle were not bred to produce at such early ages as at present, the average weight of mature Ayrshire cows was about 1,000 pounds.

CROSS-BREEDING.

A cross-bred is the progeny of two distinct breeds. Though there has been an indiscriminate mixing up of the blood of various breeds, cross-breeding in its strictest sense is not prevalent, owing to the small number of pure bred females in existence. The grades of the various breeds, however, are crossed frequently. The practice has been stimulated by sudden and somewhat prolonged fluctuations in market values; a depressed dairy market leads to more or less crossing of beef blood upon dairy types and vice versa; an increased price for the longer and

coarser staples of wool always causes more or less crossing of coarse wools upon fine wools or the reverse, as the case may be. No breeder can make such radical changes as these, frequently, for every time he alters his breeding operations so radically in trying to meet market fluctuations, he introduces factors leading to the final deterioration of his breeding stocks. It is much safer to choose some definite line of production, and stand by that through the temporary ups and downs of the market; the men who have done this have made a success of animal breeding. It would not be sensible to say that no changes should be made in one's breeding operations; if a man is sure he has made a mistake, the only rational thing to do is to make a change, but these should not be made often, as they are usually attended by some loss. The progeny from some first crosses have shown highly desirable results and while cross-breeding is more justifiable in the production of market animals, it cannot be employed continuously in the production of breeding stocks. From the breeders standpoint, each succeeding cross becomes less and less satifactory. Cross-breeding is more justifiable among those classes of animals such as swine, which reproduce quickly and abundantly, and mature early, for in such cases it is easily possible to return to the original types for breeding animals. While we must admit that cross-breeding has rendered valuable service, in the form of single out crosses, in the formation of new breeds and types, still, it should not be practiced among cattle on the ordinary farm, for three reasons, viz.: (1) It would tend to destroy the identity of breeds; (2) The results are in many cases uncertain, and (3) It might render pure bred females less capable of breeding true to type.

IN-AND-IN BREEDING.

Because of the fact that the several terms used in connection with the breeding of variously related animals are not always properly used, or understood, it may be well to define them. (1) In-and-in breeding implies the mating of animals closely related, for a number of successive generations; it includes close relationships and continuous repetition. (2) In-breeding implies the mating of related animals in a single instance, or at intervals among the generations, without much regard for the closeness of the relationship. (3) Close breeding merely implies that closeness of relationship existed between the animals mated. (4) Line breeding implies the breeding of animals within the members of one family, or one or more related families. It is virtually a continuation of in-and-in breeding, the relationships being less close.

It is astonishing the extent to which in-and-in breeding and inbreeding are allowed among the common stocks of the country, and this too, by some persons who realize fully the seriousness of the practice. It arises, of course, from the selection of sires from among the offspring of the herd; in some cases, it may be due to a lack of means to make a suitable purchase, but in general, it is due to carelessness or indifference. When in-and-in breeding is carried too far the following evils are likely to result, viz.: loss of size, delicacy of constitution, impaired reproductive powers, and in fact general deterioration.

The practice of in-and-in breeding, and in-breeding, should not be denounced entirely, for they may become useful factors when employed by those skilled in the art of breeding; they must almost necessarily be used in the formation of new breeds, where it is the aim to fix new characters in animals, and secure uniformity and permanence in the transmission of the same. But, on the other hand, the improver of common stocks has no occasion to resort to close breeding. He is not going to become a former of new breeds or types but is going to improve his common stocks through up-grading, in which he will rely solely on the prepotency of the sires chosen to work the transformations by which each succeeding generation will be brought more near to his own standard of excellence.

PREPOTENCY.

What is prepotency? "Strictly speaking, prepotency is the superior power which one parent has over the other in determining the character of the offspring. But the term is more commonly used to indicate that power which an animal has to transmit its own qualities." "If a pure male were to beget progeny from females of the same breed, which bear a close resemblance to the male parent, this result would be a stronger evidence of prepotency in the male, than a similar result produced by mating him with females of mixed breeding, since the resistance to modification in the progeny of the females in the first instance, would be stronger than resistance to the same in females in the second instance." This quality in a sire is one of the most important factors stimulating rapid improvement in any process of upgrading. It is more important in the sire than the dam, as the effect on the sire's side is more far reaching. Probably one of the most difficult things in animal breeding is to determine whether a sire is possessed of prepotency or not. It is conceded by some, that prepotency is the result of certain lines of breeding, and that certain visible characteristics must accompany it. The following are some influences tending to produce prepotency, viz.: (1) duration of purity of breeding without admixture of alien blood; (2) uniformity of type and results from animals in pedigree; (3) inherent vigor of type, race or individual; (4) line breeding. To illustrate the first point; it is well known that it matters little with what breed or type a Holstein bull is mated, the offspring is almost sure to resemble the sire markedly in characteristics, and particularly in color; it is doubtful if any breed of cattle has been bred pure for a longer period than the Holstein, and the inherent vigor of the breed is indisputable. The ability of the Hereford, also, to transmit uniformly its characteristic color markings, especially the white face, is an evidence of prepotency, the result of a long period of pure breeding. In selecting a prepotent sire, it is well to study the pedigree and ascertain as far as possible what is known relative to the performance of the ancestry as breeders, for an animal the progeny of prepotent ancestry, is certainly likely to be more prepotent than an animal whose ancestors have not been prepotent.

Illustrations Nos. 3, 4 and 5 must be considered not singly but as a group. The upper row of illustration No. 4 represents two pedigreed

Holstein cows and, below, their calves sired by the Holstein bull, Count Colantha Alban, 25148, shown in illustration No. 3.

The upper row of figure 5 represents two Shorthorn grade cows purchased for the College grade dairy herd in 1904; directly beneath these cows is to be seen their calves sired by the Holstein bull, Count Colantha Alban, (Ill. 3). We wish to direct the attention of our readers just here to the fact that in this case a Holstein bull was bred to two cows of his own breed, and two high grades of another breed, and that all four calves show Holstein type in marked degree. It is unfortunate that all the breed type characteristics existing in these individuals cannot be brought out by the camera. This group of illus-

ILLUSTRATION NO. 3.

trations demonstrates the quality known as prepotency in no small degree. Breed prepotency is shown in the characteristic Holstein type of all four calves in the illustration and individual prepotency especially in the likeness of the two calves from the pure bred cows to their sire.

DESIRABILITY OF CO-OPERATION OF BREEDERS.

It would seem highly desirable that some forms of co-operation, in breeding methods, should be established by communities, such for instance as the joint ownership and use of males by several parties rather than one. In theory this proposition sounds well, but in actual practice it has not worked satisfactorily in the majority of instances, as illustrated by the universally undesirable results from the formation

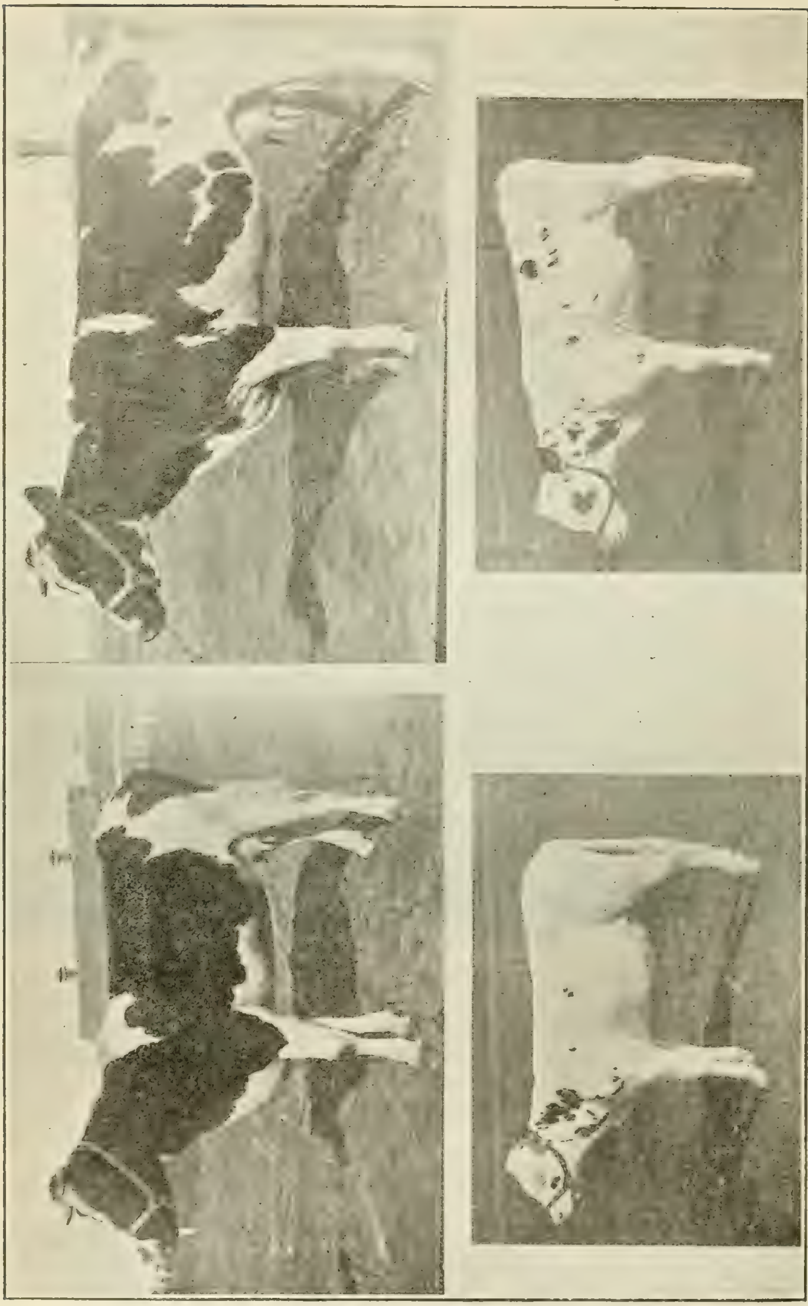


ILLUSTRATION NO. 4.

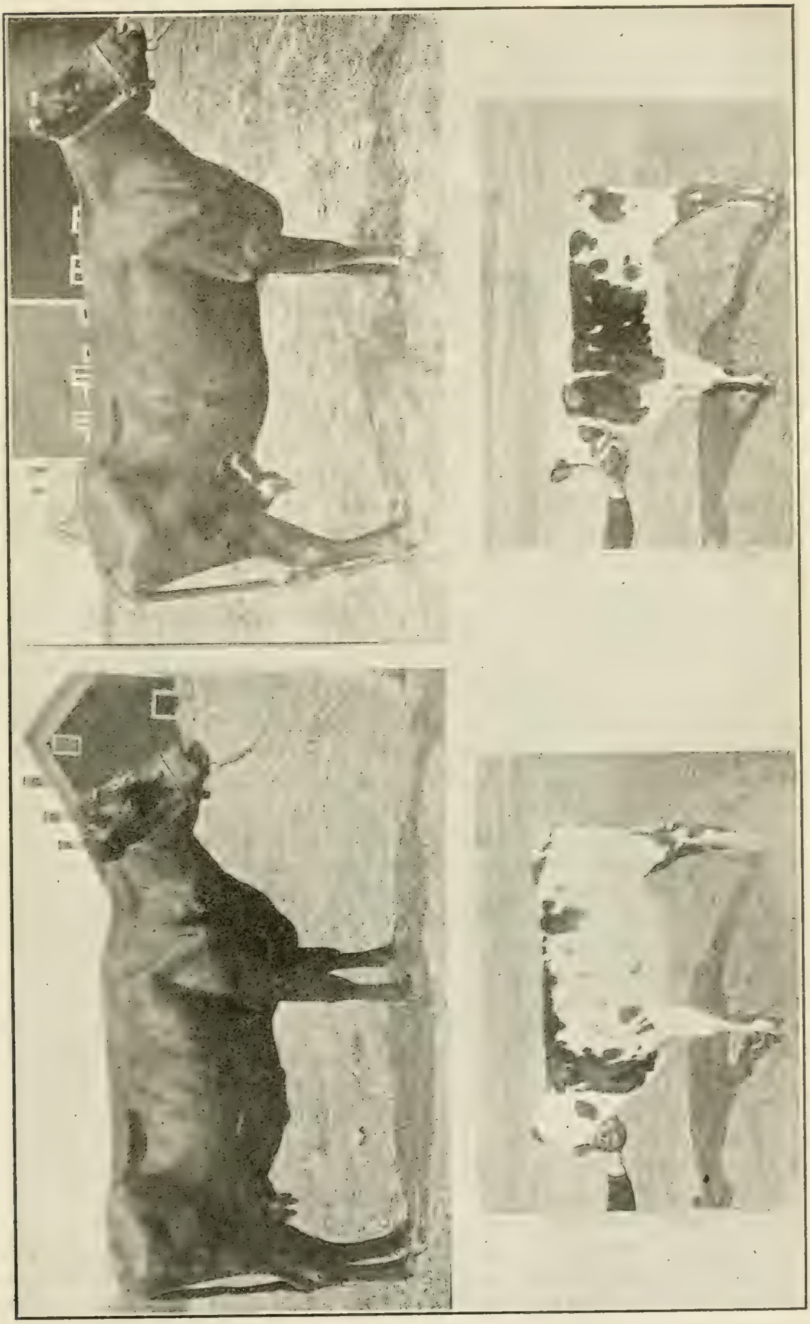


ILLUSTRATION NO. 5.

of stock companies in the ownership of stallions. In this instance, however, it is only fair to venture the assertion that the initial troubles among these companies is generally the fault of the organizer or promoter, the seller of males, who unloads something on the company that does not prove satisfactory. One cannot conceive of any logical reasons why several men in a community could not form a co-partnership in the ownership and use of good sires. If such a plan could be followed, the good influences of superior sires would become more far reaching and fewer males in all would be needed than in the case of individual ownership. At present pedigreed males are usually introduced into a community by individauls. These men usually possess small herds and the one sire could be used upon a number of other herds, providing the neighboring owners could but see the advantage to be gained thereby. But, at present the man who introduces a good male and offers his services at a reasonable price, does not greatly benefit his community, as the prevailing practice is to patronize the sire offered at the smallest fee, and this is always the grade or scrub. The scrub is likely to flourish and continue to be used until such time as national or state legislation places a prohibitive tax on him. The form of co-operation discussed would be particularly suited to thickly settled communities where the farms and holdings of cattle are small, and consequently close together. In general, it is the men with the smaller holdings of cattle who resort most to mixed breeding, and who are in greatest need of good sires.

It is highly desirable for the various breeders in a community to co-operate in other ways in addition to that just referred to. Great advantages would accrue from unity of purpose and methods in breeding. One of the great difficulties existing today is found in the fact that the blood of altogether too many breeds of a given species is to be found in each community; this facilitates the admixture of the blood of various breeds. There is really no occasion for the use of so many breeds; in fact there are some notable disadvantages. There is no disputing the fact that individual likes and dislikes vary greatly, but it nevertheless seems to be the case, that if one man introduces a certain breed, his nearest neighbor will at once introduce another, apparently for no other purpose than to have something different, whereas, if they were both using the same blood it would work to their mutual advantage.

Probably it would not be wise to advocate a single breed of cattle, for instance, for each community, but it would unquestionably be wise to limit the breeds to those only which are peculiarly adapted to the conditions of each community and the lines of production therein pursued. The greatest success that has been achieved in the history of animal breeding has occurred where there were harmonious community interests, and but one principal line of breeding. Examples are numerous, for instance, Jerseys only have been bred on the Isle of Jersey, Holsteins in Holland, and all the leading breeds of cattle and sheep in England and Scotland were each developed largely within one or more counties or shires, to the almost total exclusion of other breeds of the same species. That county in Michigan, noted more than any other today for its Holstein cattle, is the one possessed of the greatest number of Holstein breeders, who are organized and possess some

unity of purpose. When a given community is specializing in the production of some one or two breeds of cattle, it soon becomes noted for these breeds, and prospective purchasers are attracted thereby to the mutual interest of all those co-operating in the work.

There is a great lack of proper organization among Michigan stockmen today. It is true that a state live stock breeders' organization exists, and also that there are a number of breeders' associations, and one or two county live stock organizations. It would seem highly desirable for most counties and perhaps some townships, to organize live stock breeders' organizations. It would seem possible through such organizations, to bring the live stock breeders into closer touch with one another, and thereby present favorable opportunities for the discussion and adoption of methods of breeding best suited to the interests of the community.

FEEDING WHOLE GRAIN.

BY R. S. SHAW AND H. W. NORTON, JR.

Bulletin No. 242.

The plans of this experiment were executed and the material prepared for publication by Mr. Norton.

For some time past the system of feeding whole grain has had many advocates. Some speakers and writers on agricultural and live stock subjects have advised the use of whole corn, either alone, or in conjunction with other grains for steer feeding, and many farmers are feeding whole oats to cows, young stock, and calves.

The presence of large quantities of oats in the droppings from cows fed a grain mixture containing whole oats, and the fact that a field manured with these droppings produced a fairly good stand of oats, suggested this experiment to determine the percentage of whole grain passing through the digestive tract. The investigation later on in this experiment shows that only a small percentage of the grain which passed through the system unmasticated would germinate, but when a field was heavily manured with the droppings, even the small per cent which would germinate would produce quite a stand of the grain.

No attempt was made to compare the feeding value of whole grain with ground grain, nor was any attempt made to ascertain the gains or losses in weight made by the animals while on the whole grain feed.

Claims are also made by advocates of this method of feeding that even though a large amount does pass through without apparent change, still the animal "gets a lot of good out of it." To clear up this last question, chemical analyses were made to find the exact composition of the grain, both before and after feeding, in order to detect any changes taking place.

PLAN OF EXPERIMENTS.

The plan of the experiment was to feed mature cows, yearling heifers and calves, six animals of each class. Three different rations were used, one of whole corn, one of whole oats, and one whole oats 4 parts, whole corn 4 parts, and bran 2 parts, the supplementary feed being, in all cases, clover hay, which they received as needed. Every animal of the eighteen under experiment received each of the grain rations during the test.

All the animals were kept in the stable continuously and watered twice daily. Each feeding period lasted seven days of 24 hours each, during which time all grain fed was weighed, and all droppings collected and washed through screens to separate the grain. The screens were as fine meshed as could be used, and still allow the escape of everything but the grain, in fact some of the oats were washed through and lost. Ordinary window screen was tried first, but was too fine, and

a long mesh screen from a fanning mill was used. The grain was then spread out in a warm room and dried and run through a fanning mill to clear from straw and chaff, and was finally weighed. Samples were taken for chemical analyses. In the tables following, all figures are given on a water-free basis, as it was impossible to dry the grain to the same moisture content that it had before feeding. During all of these operations the grain recovered from the droppings of each cow for each seven day period was kept separate, so that individual records could be made. One week was taken for preliminary feeding with each change of the ration, and the animals were put on full feed at least forty-eight hours before the start of the seven day test period, in order that the full amount would be passing through the system when the droppings were collected for washing.

ANIMALS USED.

The cows were selected from the Grade Dairy Herd.

Cow No. 1 was Grade 16.
Cow No. 2 was Grade 17.
Cow No. 3 was Grade 14.
Cow No. 4 was Grade 22.
Cow No. 5 was Grade 30.
Cow No. 6 was Grade 21.

The yearling heifers were taken from the Pure-bred Dairy Herd.

Heifer No. 1—Registered Holstein.
Heifer No. 2—Registered Holstein.
Heifer No. 3—Registered Holstein.
Heifer No. 4—Registered Red Poll.
Heifer No. 5—Registered Guernsey.
Heifer No. 6—Registered Ayrshire.

The calves were Holstein grades owned by Mr. G. W. Brown, a neighboring farmer. They were about six months old at the start of the experiment, had been raised on skim-milk, clover hay and whole oats, and were in fair condition; they number from 1 to 6 consecutively.

FEEDING.

During the first period cows Nos. 1 and 2 received corn, Nos. 3 and 4 oats, and Nos. 5 and 6 corn, oats and bran. They were fed 11 pounds per head daily, 5½ pounds at each feed, morning and evening. In addition, each cow had as much clover hay as she would eat up clean. One week was taken to get them on feed, and one week again with each change of the ration. During the second period, cows Nos. 1 and 2 received oats, Nos. 3 and 4, corn, oats and bran, and Nos. 5 and 6, corn. In the third period, cows Nos. 1 and 2 were fed corn, oats and bran, Nos. 3 and 4, corn, and Nos. 5 and 6, oats. During all three periods the cows had the same amount, 11 pounds per head daily, or 77 pounds per week.

The heifers were fed in the same way, receiving 6 pounds per head daily, or 42 pounds per week.

The calves were started on a ration of 3 pounds per day, or 21 pounds per week. Nos. 1 and 2 receiving corn, Nos. 3 and 4 oats, and Nos. 5 and 6 corn, oats and bran. Some trouble was experienced in keeping them up to this amount of feed, however, and during the last two periods 2 pounds per day, or 14 pounds per week was the allowance. All grain fed was weighed, and individual records kept with each animal.

In the process of washing some of the oats escaped through the screens, but the corn was nearly all saved. In the mixture of corn, oats and bran, the bran, of course, was lost entirely, and the percentages given are figured on the basis of corn and oats fed after taking out the weight of the bran.

The following tables show the amount of grain consumed by each animal, percentage of dry matter, total weight of dry matter consumed, weight of grain washed out from the droppings, per cent dry matter, total pounds dry matter, and per cent of whole grain left.

TEST WITH COWS.

Cows consumed 77 pounds corn per head per week, corn contained 88.15% Dry Matter.

Cow.	Total dry matter consumed, pounds.	Weight of grain from droppings, pounds.	Per cent dry matter.	Total pounds dry matter.	Per cent left whole.
No. 1	67.875	21.6	91.33	19.727	29.06
No. 2	67.875	24.7	91.33	22.528	33.08
No. 3	67.875	17.9	90.317	16.165	23.81
No. 4	67.875	17.8	89.82	15.987	23.55
No. 5	67.875	12.8	91.33	11.690	17.22
No. 6	67.875	7.3	91.33	6.667	9.827
Average	67.875	17.01	90.90	15.460	22.75

Cows consumed 77 pounds whole oats per head, per week.

Oats contained 93.13% Dry Matter.

Cow.	Total dry matter consumed, pounds.	Weight of grain from droppings, pounds.	Per cent dry matter.	Total pounds dry matter.	Per cent left whole.
No. 1	71.71	10.6	93.23	9.882	13.78
No. 2	71.71	15.8	93.23	14.730	20.54
No. 3	71.71	7.5	93.23	6.992	9.75
No. 4	71.71	9.2	93.23	8.577	11.96
No. 5	71.71	7.7	92.78	7.144	9.96
No. 6	71.71	4.9	93.19	4.566	6.36
Average	71.71	9.18	93.25	8.648	12.06

Cows consumed 77 pounds of the mixture, corn 4, oats 4, bran 2, per week.

Corn and oats contained 90.64% Dry Matter.

Cow.	Corn and oats fed, pounds.	Dry matter consumed, pounds.	Weight of grain from droppings, pounds.	Per cent dry matter.	Total pounds dry matter.	Per cent left whole.
No. 1	61.6	55.83	12.4	90.96	11.279	20.20
No. 2	61.6	55.83	25.7	91.26	23.453	40.21
No. 3	61.6	55.83	15.5	92 34	14.312	25.63
No. 4	61.6	55.83	11.5	92.34	10.619	19.02
No. 5	61.6	55.83	18.1	92.34	16.713	29.93
No. 6	61.6	55.83	14.4	92.34	13.296	23.81
Average	61.6	55.83	16.26	91.93	14.945	26.46

Comparison of the amounts fed with the amounts washed from the droppings on water-free basis, shows a marked difference in percentage of loss—26.46% of the corn and oats fed passed through the digestive tract unmasticated, 22.75% of the corn, and only 12.06% of the oats. The smaller percentage of oats may be accounted for partly by the fact that a small amount was lost in washing. Why there should be a larger percentage left with the ration of corn, oats and bran than with either corn or oats above, is difficult to explain.

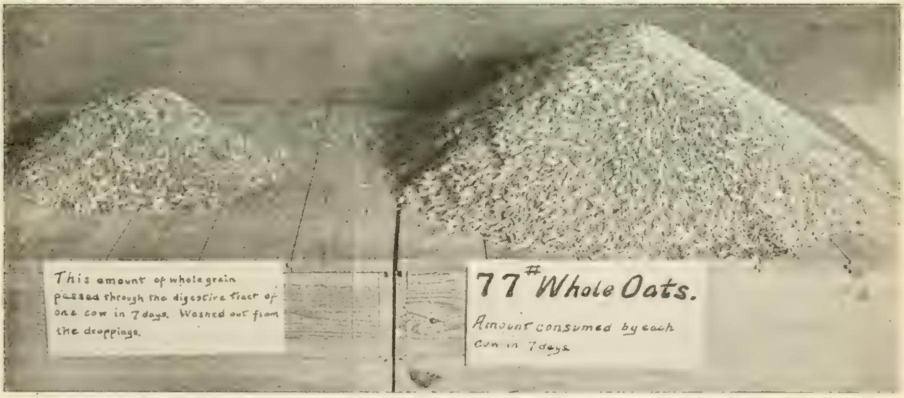


Illustration No. 1.

Illustration No. 1 shows the amount of whole oats consumed by each cow in 7 days and the amount excreted unmasticated and undigested. Illustration No. 2 shows the amount of whole corn, whole oats and bran consumed by each cow in 7 days and the amount of whole corn and whole oats excreted unmasticated and undigested. Illustration No. 3 shows the amount of whole corn consumed by each cow in 7 days and the amount excreted unmasticated and undigested.

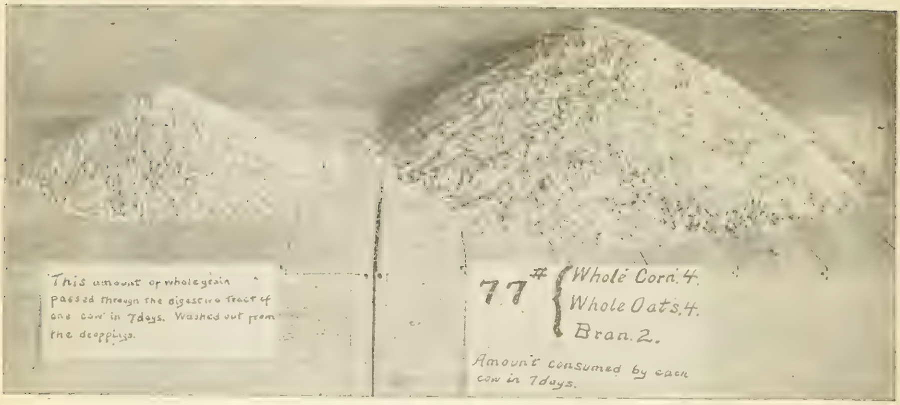


Illustration No. 2.

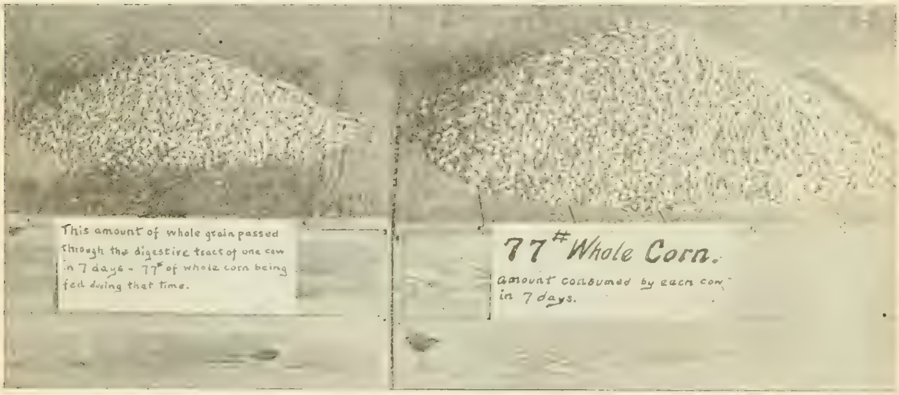


Illustration No 3.

TEST WITH HEIFERS.

Heifers consumed 42 pounds corn per week. Corn contained 88.15% Dry Matter.

Heifer.	Dry matter consumed, pounds.	Weight of grain from droppings, pounds.	Per cent dry matter.	Total pounds dry matter.	Per cent left whole.
No. 1	37.02	5.2	91.31	4.748	12.82
No. 2	37.02	5.1	91.31	4.656	12.57
No. 3	37.02	2.6	90.09	2.342	6.32
No. 4	37.02	4.2	90.62	3.806	10.28
No. 5	37.02	5.6	91.31	5.113	13.81
No. 6	37.02	3.6	91.31	3.287	8.87
Average	37.02	4.36	90.99	3.992	10.77

Heifers consumed 42 pounds oats per week. Oats contained 93.13% Dry Matter.

Heifer.	Dry matter consumed, pounds.	Weight of grain from droppings, pounds.	Per cent dry matter.	Total pounds dry matter.	Per cent left whole.
No. 1	39.114	2.2	93.32	2.053	5.24
No. 2	39.114	2.4	93.32	2.239	5.72
No. 3	39.114	2.1	93.32	1.959	5.00
No. 4	39.114	2.3	93.32	2.146	5.48
No. 5	39.114	2.9	93.56	2.713	6.93
No. 6	39.114	1.9	93.03	1.767	4.51
Average	39.114	2.3	93.31	2.146	5.48

Heifers consumed 42 pounds of the mixture, corn 4, oats 4, and bran 2, per week. Corn and oats contained 90.64% Dry Matter.

Heifer.	Corn and oats fed, pounds.	Dry matter consumed, pounds.	Weight of grain from droppings pounds.	Per cent dry matter.	Total pounds dry matter.	Per cent left whole.
No. 1	33.6	30.45	4.8	92.26	4.428	14.54
No. 2	33.6	30.45	5.2	92.22	4.795	15.74
No. 3	33.6	30.45	3.6	92.92	3.345	10.98
No. 4	33.6	30.45	4.8	92.92	4.460	14.64
No. 5	33.6	30.45	10.7	92.92	9.942	32.65
No. 6	33.6	30.45	5.4	92.92	5.017	16.47
Average	33.6	30.45	5.75	92.69	5.331	17.50

A comparison of the results from the heifers shows as with the cows a greater loss with the corn and oats fed together, than with either when fed separately, and the oats alone showed the smallest percentage loss of the three. Much smaller percentages of whole grain were found in every case than with the cows.

TEST WITH CALVES.

Grain Ration of Whole Corn.

Calf.	Amount fed, pounds.	Per cent dry matter.	Pounds dry matter consumed.	Weight of grain from droppings, pounds.	Per cent dry matter.	Total pounds dry matter.	Per cent left whole.
No. 1	21.0	88.15	18.511	2.2	89.82	1.976	10.67
No. 2	21.0	88.15	18.511	1.8	89.50	1.611	8.75
No. 3	14.0	88.15	12.341	0.7	90.15	.631	5.11
No. 4	14.0	88.15	12.341	1.0	90.25	.902	7.30
No. 5	14.0	88.15	12.341	0.7	91.57	.640	5.18
No. 6	14.0	88.15	12.341	0.1	89.16	.089	0.72
Average	16.3	88.15	14.397	1.08	90.07	.975	6.28

Grain Ration of Whole Oats.

Calf.	Amount fed.	Per cent dry matter.	Dry matter consumed, pounds.	Weight of grain from droppings, pounds.	Per cent dry matter.	Total dry matter. pounds.	Per cent left whole.
No. 1	14.0	93.13	13.038	0.2	91.67	.183	1.40
No. 2	14.0	93.13	13.038	0.3	91.90	.275	2.10
No. 3	21.0	93.13	19.557	1.0	90.91	.909	4.64
No. 4	21.0	93.13	19.557	1.2	91.17	1.094	5.59
No. 5	14.0	93.13	13.038	0.4	91.45	.365	2.79
No. 6	14.0	93.13	13.038	0.2	91.46	.182	1.39
Average	16.3	93.13	15.211	0.55	91.42	.501	2.98

Grain Ration of Whole Corn, Oats and Bran.

Calf.	Amount fed, lbs.	Corn and oats fed, pounds.	Per cent dry matter.	Total dry matter, lbs.	Weight of grain from droppings, pounds.	Per cent dry matter, lbs.	Total dry matter, lbs.	Per cent left whole.
No. 1	14.0	11.2	90.64	10.15	0.5	91.17	.455	4.48
No. 2	14.0	11.2	90.64	10.15	0.5	90.30	.451	4.44
No. 3	14.0	11.2	90.64	10.15	0.6	91.50	.366	3.60
No. 4	14.0	11.2	90.64	10.15	0.4	90.08	.540	5.32
No. 5	21.0	16.8	90.64	15.22	1.6	89.98	1.439	14.17
No. 6	21.0	16.8	90.64	15.22	0.3	90.74	.272	2.67
Average	16.3	13.06	90.64	11.84	0.65	90.62	.587	5.78

The results with the calves differ from the cows and heifers, in that a larger proportion of the corn ration was left whole than of the corn and oats, fed together.

Average Percentage of Grain Left Whole.

	Corn. %	Oats. %	Corn and oats. %
Cows	22.75	12.06	26.46
Heifers	10.77	5.48	17.50
Calves	6.28	2.98	5.78

The above table shows a uniform decrease in the per cent left unmasticated from the cows down to the calves, with all three rations. In every case the oats showed the least waste, and with the cows and heifers the combination ration showed the most, but with the calves the largest percentage of unmasticated grain was with the corn ration.

In order to determine whether any nutriment had been taken from the grain during its passage through the digestive tract, chemical analyses were made, both of the grain as fed, and of samples of the grain washed

from the droppings. The analyses were made by Mr. A. J. Patten, Experiment Station Chemist. The percentage composition in every case, in the following tables, is reported on a water-free basis. This is necessary to give fair comparisons, as the samples from the manure could not be dried back to their exact original moisture content.

The tables give the percentage composition water-free basis of all three grain rations, both before and after feeding to cows, heifers and calves.

Table Showing Composition of Corn.

	Ash.	Protein.	Fat.	Crude fibre.	N-free extract.
Corn as fed	1.47	8.66	4.72	2.19	82.96
Corn from cows	0.87	8.57	4.78	2.13	83.63
Corn from heifers	1.07	8.49	4.73	2.25	83.43
Corn from calves	1.77	9.19	4.45	2.52	82.05

Table Showing Composition of Oats.

	Ash.	Protein.	Fat.	Crude fibre.	N-free extract.
Oats as fed	3.23	12.08	5.81	10.80	68.07
Oats from cows	2.85	11.93	6.14	10.23	68.83
Oats from heifers	2.88	12.64	5.95	9.64	68.86
Oats from calves	3.49	13.10	5.79	10.61	66.98

Table Showing Composition of Corn and Oats.

	Ash.	Protein.	Fat.	Crude fibre.	N-free extract.
Corn and oats as fed	2.35	10.37	5.26	6.49	75.51
Corn and oats from cows	1.64	10.40	5.49	5.02	77.44
Corn and oats from heifers	2.09	9.71	5.07	4.19	78.72
Corn and oats from calves	2.57	10.73	5.10	6.31	75.26

The above tables are the averages taken from analyses of samples for each animal. The differences in composition of the original grain, as compared with the samples from the droppings, are slight in every case. The increase in percentage of some of the constituents is due to the removal of a larger proportion of the others. In each case the greatest amount of ash was taken out by the cows, and the least by the calves, but with the Nitrogen-free extract the reverse is true—the calves taking out more than the cows. The changes in protein, fat, and crude fibre show no regularity, and are too small to be of importance. From these

results, then, it may be said that practically no nutriment is taken from the grain which passes through the system without mastication, as the chemical analysis showed no appreciable change in the composition.

GERMINATION TEST.

Germination tests were made for the purpose of finding the effect upon the vitality of the seeds after passing through the digestive tract. The germinating was tried in pans of sand, with one hundred seeds to the pan, kept well moistened and in a warm room. The average of several tests are given, five hundred seeds of each kind being tested.

Corn as fed	84 %	germinated
Corn from droppings	4.3%	"
Oats as fed	99.6%	"
Oats from droppings	10.6%	"

SUMMARY OF RESULTS.

Whole corn not masticated:

Cows	22.75%
Heifers	10.77%
Calves	6.28%

Whole oats not masticated:

Cows	12.06%
Heifers	5.48%
Calves	2.98%

Whole corn and whole oats not masticated:

Cows	26.46%
Heifers	17.50%
Calves	5.78%

Chemical analyses showed practically the same composition of grain as before feeding, therefore it is safe to conclude that the animal derives no benefit from grain which passes through the digestive tract unmasticated.

The germinating power of the grain, passing through the system was affected very markedly, but not entirely destroyed, as 4.3% of the corn and 10.6% of the oats germinated after this treatment.

CULL BEANS AS A FOOD FOR SWINE.

R. S. SHAW AND A. C. ANDERSON.

The plans of this experiment were executed and material prepared for publication by Mr. Anderson.

Bulletin No. 243.

The State of Michigan has long been noted for the magnitude and superiority of its bean crop. The yearly acreage ranges between 150,000 and 350,000 acres, with a total production of between 1,500,000 and 5,000,000 bushels per annum.

While the peculiarities of the season and weather conditions at harvest have much to do with the quality of the crop, it is probably safe to estimate that at least 5 per cent, and in exceptional years as high as 10 per cent, fall into the class known as cull or damaged beans. It is also reported, by persons engaged in the business, that probably about one-half of the culls are used for feeding purposes.

If this be true there must then be available for feeding approximately 100,000 bushels of cull beans from an average crop; while for years of exceptionally large acreage or yield, or exceptionally unfavorable weather the number of bushels used for feeding purposes must be far in excess of that amount.

A large number of inquiries come to this station relative to the feeding value of cull beans, the different farm animals to which they may be fed, the gains which may be expected from their use, and the different methods of using them, to convert this important and cheap by-product into a marketable article.

Mixed with other grains, cull beans may be fed to sheep, and large quantities are used in this state for this purpose each year; it is reported that they are used as a food for dairy cows; they are also fed to swine, and it is as a swine food that they are to be considered in this bulletin.

While this work is undertaken in an effort to furnish information to a large number of inquiring residents of this state, it is not desired to advocate the extensive use of beans as a swine food, especially in the fattening or finishing period. Pork from hogs which have been fattened quite largely on beans is generally soft and lacking in quality. If a considerable portion of the pork produced in the state were of this kind it would lower prices and work serious harm to the swine industry.

It is generally conceded that bean-fed hogs store up a fat having a lower melting point, and consequently a softer fat, than hogs fed upon many other feeds; and that a considerable portion of the element called quality in pork is dependent upon the melting point or character of the fat stored up. In the case of mutton finished upon beans no such criticism has been made, probably because there is relatively less fat in the carcass of the sheep, and its character is not so essential to the quality of the meat as in the case of the pig.

A still further reason for conducting the experiments here reported

is that a cheap feed must generally be selected to produce pork with reasonable profit. There are, of course, exceptions, but usually the profit accruing from rearing pigs for slaughter on mill-feeds alone at hundredweight prices is extremely small. It is the nitrogenous or protein element in the feeds which is the most expensive factor, and feeds rich in protein are consequently high in price. As the necessity for the nitrogenous element in food has become better known and its place in the economy of feeding better understood, the feeds rich in protein have been more and more sought for the growing animal. Bulletin 237 sets forth the value of skim-milk in pig rearing and calls attention to the necessity of seeking substitutes for it in cheese factory, condensery and city milk supplying districts. It was then in an attempt to discover in how far the growing pig could profitably be compelled to rely upon the bean factor in his food for his supply of protein that one of the series of trials here reported was undertaken.

Investigations were carried on with two different classes or weights of hogs, representing two of the stages in pork production, the one—the growing period—commencing a little after weaning at about 50 pounds weight and closing at about 150 pounds; the other—the fattening or finishing period—beginning at about 150 pounds and ending at from 225 pounds to 250 pounds.

In the computation of costs of gains the different foods used are charged at the following prices, viz.:

Cornmeal, $20.00 per ton.

Middlings, $20.00 per ton.

Cull beans, $12.00 per ton.

Skim-milk, 20 cents per hundred pounds.

It is not intended that these prices will correspond with the local prices charged in the different sections of the state. In fact, such a coincidence could not be expected. The prices are, however, intended to represent about the average yearly prices which have prevailed in the Michigan markets for the respective feeds during the past two or three years. When the prices charged for experimental feeds are known the reader can readily adapt the result to his locality by simply substituting his local prices for those assigned here.

PART I.

Beans for Growing Pigs.

Six trials were made with cull beans and growing pigs. Two different combinations of feeds were tried and two check lots were fed for comparative purposes. The farmer frequently asks that feeding trials be made with feed combinations, all factors of which are produced on the farm; accordingly four trials were conducted using cornmeal with beans; two using cornmeal, middlings and beans, and two using cornmeal and skim-milk. In all of the eight trials the middlings is the only food factor which is not immediately of the farm.

Trials 1 *and* 2. These were conducted during the winter of 1905-06, beginning December 5, 1905, and closing February 13, 1906.

Rations.—In both cases the rations consisted of beans three parts and cornmeal four parts by weight. The preparation of the mixture was

as follows: The dry beans were weighed out, placed in the feed cooker with sufficient water, and cooked until done, or until all were soft. The cooked beans, including the entire contents of the kettle, were then transferred to a barrel, the proper amount of cornmeal added and the whole thoroughly mixed. From this mixture the pen of pigs was fed as much as they would readily consume and still show good appetites and eagerness for the next feed.

Pigs Used.—The pigs in Lot 1 were five Berkshire-Tamworth cross breds and those in Lot 2 were four Duroc-Jersey-Tamworth cross breds. The average weight of the nine pigs at start was 46 pounds.

Trials 3 and 4.—These were conducted during the summer of 1906, beginning June 26 and closing September 4.

Rations.—The rations used were the same as those used in the first two trials and the method of preparing the feed was the same. Since these two lots were fed during the warm weather, it was necessary to cook feed oftener and in smaller quantities to prevent excessive souring.

Pigs Used.—Each lot was made up of four Berkshire-Yorkshire cross bred pigs put on feed at an average of 55 pounds weight. For comparison, the results and data of these four trials are set forth in the following table:

Table I.

Lot.	Initial weight.	Closing weight.	Total gain.	Average gain per head per day.	Food consumed.		Total cost of food.	Cost per hundredweight gain.
					Beans.	Cornmeal.		
I.	228.6	507.6	279	.797	426	568	$8.24	$2.95
II.	185	447.6	262.6	.93	400	533	$7.73	$2.94
III.	224.3	510	285.7	1.02	396	528	$7.66	$2.68
IV.	222.3	513.6	291.3	1.04	396	528	$7.66	$2.63

From the above table it will be seen that the cost per hundredweight of gain at the feed prices heretofore quoted ranges from $2.63 in the case of Lot 4, to $2.95 for Lot 1, the average of the four lots being $2.80. This portion of the results is entirely satisfactory. There is an opportunity for a good measure of profit in pork production when pigs ranging between 50 and 125 pounds, fed in pens and dry lots on grain alone, without the addition of any green or especially cheap feed, can be made to produce gains at a food cost of less than $3.00 per hundred pounds.

It will also be observed from the table that the average gain per head was less than 8-10 of a pound per day in Lot 1, while in Lot 4, which made the largest daily gains, it was only a trifle over one pound per day. With the conditions under which these pigs were fed these gains could hardly be called satisfactory. An examination of the records of

Lots 7 and 8, which follow in this series, will show that they were from the same litters as those of Lots 3 and 4, and were fed skim-milk and cornmeal as a check ration. Their daily gains were one-third of a pound more and at the close of the feeding period they averaged 25 pounds more per pig than those fed on cornmeal and beans.

Trials 5 *and* 6.—From daily observation of each of the four lots which were fed on beans and cornmeal, it was apparent that the food combination, while it possessed the proper amounts of carbohydrates and protein, was not well enough adapted to the requirements of the pigs to produce adequate growth. It was thought that the introduction of a less concentrated food factor would give variety to the ration, and at least a physical composition better suited to the age and digestive powers of the pigs. Accordingly middlings was substituted for a part of the beans used.

The trials were conducted during the winter and spring of 1906, beginning January 23, 1906, and closing April 3, 1906.

Rations.—The rations of both lots were the same, and were made up of cornmeal three parts, middlings two parts, and cull beans two parts. The method of preparation was the same as that described in Trials 1 to 4.

Pigs Used.—Each lot was made up of two pure bred Berkshires, and three pure bred Yorkshires, the average weight of the ten pigs at date of starting the experiment being 73 pounds. The feeding period was ten weeks or seventy days. The following table sets forth the main portions of the data:

Table II.

Lot.	Initial weight.	Closing weight.	Total gain.	Av. gain per head per day.	Food Consumed.			Total cost of food.	Cost per hundred-weight gain.
					Beans.	Cornmeal.	Middlings.		
V.	364.7	828.3	463.5	1.32	477	715.5	477	$14.79	$3.19
VI.	366.	840.3	474.3	1.35	459	688.5	459	$14.23	$3.00

From the above it will be observed that the daily gains per head range between 1.32 pounds and 1.35 pounds, the average for all being approximately 1⅓ pounds. Also, following the schedule of prices previously given, that the cost per hundredweight of gain ranges from $3.00 to $3.19; the average for both lots being $3.09.

While the gains obtained with the above food combination were not exceedingly large, they were sufficient, in view of the restraints generally necessary with experimental pigs, to be called quite satisfactory. The cost of production is also quite reasonable. If the reader wishes to compare these results with those obtained from the use of cornmeal and beans in Lots 1 to 4 inclusive, he might assume that the pigs were worth 5 cents per pound live weight at the close of each experiment; as a matter of fact they were worth more than that. The first four lots produced 1,118.6 pounds gain at a food cost of 2.8 cents per pound.

and if sold at 5 cents there would be a margin or profit of 2.2 cents per pound, or a total profit of $24.61 for seventeen head, which is a profit of $1.45 per pig.

Lots 5 and 6 produced 937.8 pounds of gain at a food cost of 3.09 cents, and if sold for 5 cents there would be a margin or profit over food of 1.91 cents per pound, and a total profit of $17.91 for ten head, which is a profit of $1.79 per pig. There would then be a margin of 34 cents per pig in favor of using the middlings with the beans and cornmeal. Further, since these pigs were all being fed for growth and development of frame and feeding capacity rather than for mere gains, the results from the use of the middlings was more beneficial than a comparison of pounds of gain would indicate.

CHECK LOTS.

Skim-milk and Cornmeal.—In the whole list of feeds suitable for pig growing which are available to the farmer, probably the one which he would choose first would be skim-milk. Certain it is that such uniformly good results have been obtained from its use that a ration of which it forms a reasonable part is, in popular opinion, a standard, and has been used quite widely for check or comparative purposes in swine experimentation. It was adopted in this experiment as a check protein feed with which to compare cull beans, and a mixture of cull beans and middlings, the carbohydrate portion of the ration in each case being obtained from cornmeal.

Trials 7 and 8.—These trials were conducted during the spring and summer of 1906, and were immediately associated with Trials 3 and 4.

Rations.—The ration in each case was composed of a mixture by weight, of skim-milk 5 parts and cornmeal 1 part weighed and mixed at the time of each feeding. The milk was sour when fed, but no portion of it was allowed to stand in the barrel more than twenty-four hours before use.

Pigs Used.—The pigs used were four Berk-Yorkshire cross breds in each pen and were from the same litters as those used in Trials 3 and 4. They were put on feed at the same time and all conditions except food supply were the same throughout.

The results are set forth in the following table:

Table III.

Lot.	Initial weight.	Closing weight.	Total gain	Av. gain per head per day.	Food consumed.		Total cost of food.	Cost per hundred-weight gain.
					Skim-milk.	Cornmeal.		
VII.	221.6	602.6	381.	1.36	3480	696	$13.92	$3.65
VIII.	223.	594.6	371.6	1.32	3480	696	$13.92	$3.74

From the table given it will be observed that Lot 7 gained a total of 381 pounds or an average of 1.36 pounds daily for the entire feeding period of 70 days. Also, that the cost of these gains at the adopted

feed prices was $3.65 per hundred pounds. Lot 8 fed upon the same feed and consuming the same amounts of feed gained 371.6 pounds during the 70 days, or an average of 1.32 pounds per head per day at a cost of $3.74 per hundred pounds gain.

The average gain for the eight pigs while increasing in weight from approximately 50 pounds to 150 pounds was 1.34 pounds per day, and the average cost of production was $3.69 per hundredweight.

Expressed in round numbers one may say that the gains were 1⅓ pounds per day at a cost of 3⅔ cents per pound.

Such a large amount of experimental data is available relating to the cost of pork production by the use of cornmeal and skim-milk that it was not considered necessary to feed check lots for all the trials. If an average of the trials reported by other stations be made it will be found that, when the conditions of feeding were approximately those under which the feeding for these reports was done, the daily gains range not far from one and one-third pounds per head per day, and in those trials where food values approximate those assigned here, the cost of food is about three and two-thirds cents per pound of gain. To quote specifically Beach & Garrigus, of Conn. report an average daily gain of 1.27 pounds for 14 pigs fed under quite similar conditions.

PART II.

Cull Beans for Fattening Swine.

In making this portion of the report we must repeat what has previously been mentioned relative to the influence of beans on the quality of the pork produced, and add that "Canadian packers have observed that shipments coming from the bean-growing districts of Ontario contain a large percentage of "softs."

From many inquiries and reports received from the farmers of the state it was known that many were using beans alone for fattening swine. Some of these told of large gains and others of unsatisfactory ones. Some that had corn were even selling this and buying damaged beans, feeding these exclusively, instead of making a combination of the two feeds. Such feeding must necessarily be accompanied with some losses of protein, and from the standpoint of food economy is open to considerable criticism. However, if the beans were cheap the practice might be financially allowable. When any feed is cheap and a large stock of it is on hand there is a great temptation to supply it too freely, and to feed it to the exclusion of other feeds which experience and judgment would suggest.

A series of three comparisons were made during the winter and spring of 1906, between the exclusive bean ration for fattening hogs, and one composed of equal parts of beans and cornmeal. In each comparison the duplicate pens of pigs were from the same litter and their previous feeding and management had been the same. They were divided evenly as could be as to weight, sex and general thrift and every precaution taken throughout the experiments to have an equality of all surrounding conditions. In each case there was a preliminary feeding period of about ten days, to gradually accustom the several pens to

their respective feeds, after which they were again weighed for the experiment proper.

In these as in all the other tests the initial and closing weights were each the average of three weighings made at 10 a. m. 2 p. m. and 4 p. m. of the starting and closing days.

As has been previously stated, it was the intention to start as nearly as possible at an average of 150 pounds weight, and close the work as soon as either pen averaged 250 pounds.

In Comparison No. I, the feeding period was seventy days. In Comparisons Nos. II and III it was 56 days. However, in the case of Comparison No. I, two of the six pigs fed on the exclusive bean ration went so badly off feed during the first two weeks that at the end of the second week they were withdrawn from the experiment and the remaining four weighed in again; consequently the gains for Pen 1 are computed for eight weeks instead of ten, as in the case of Pen 2.

The pigs used in Comparison No. I were Poland-China-Chester White cross breds, purchased from a farmer near the College. Those used for Comparison No. II were a Duroc-Jersey-Tamworth cross and those for Comparison No. III were Berkshire-Tamworth cross breds reared at the College.

The following tables present the facts in condensed form, each of the six pens being given a separate number to prevent confusion. In these as in all other tables of this bulletin, cost of labor is not considered and feeds are charged at the schedule prices previously given.

Comparison I.

Pen number.	No. of pigs in pen.	Initial weight.	Closing weight.	Total gain.	Average gain per head per day.	Food consumed.		Total cost of food.	Cost per cwt. gain
						Beans.	Cornmeal.		
1	4	578	821.6	243.6	1.08	1075		$6.46	$2.65
2	6	874	1504.6	630.6	1.50	1268	1268	$20.29	$3.21

Comparison II.

Pen number.	No. of pigs in pen.	Initial weight.	Closing weight.	Total gain.	Average gain per head per day.	Food consumed.		Total cost of food.	Cost per cwt. gain.
						Beans.	Cornmeal.		
3	4	694.3	962.3	268	1.19	1060		$6.36	$2.37
4	4	679.3	1032	352.7	1.57	730	730	$11.68	$3.31

Comparison III.

Pen number.	No of pigs in pen.	Initial weight.	Closing weight.	Total gain.	Average gain per head per day.	Food consumed.		Total cost of food.	Cost per cwt. gain.
						Beans.	Cornmeal.		
5	4	684.6	916.6	232	1.03	995		$5.97	$2.57
6	4	675.3	1012.3	337	1.50	685	685	$10.96	$3.25

A study of the tables reveals the fact that there are greater variations in gains and consequently in cost of the same in the case of the bean-fed hogs than with those fed on the mixed ration. From daily observation of the several pens while on feed it was also apparent that greater individual differences were developed with those pens which received the exclusive bean ration; that is to say, that some of the hogs receiving beans only, either by reason of their stronger constitution or better digestive and assimulative capacities or for still other reasons, seemed able to adapt themselves to the food given better than others receiving the same food from the same trough. There are, of course, individual differences and individual peculiarities which appear in all feeding operations, but these are intensified or at least rendered more apparent when feeding an extremely narrow or an extremely wide ration. Consequently less uniformity of results could be expected from the use of wide or narrow rations than from balanced rations.

A summation of the results obtained from each of the combinations of feeds, arranged in separate groups is given below.

Summary for Bean-Fed Hogs.

Number of pigs.	Initial weight.	Closing weight.	Total gain.	Average gain per head per day.	Total pounds beans consumed.	Pounds beans consumed per cwt. gain.	Total cost of food.	Cost per cwt. gain.
12	1956.9	2700.5	743.6	1.1	3130	420.9	$18.78	$2.53

Summary for Bean- and Cornmeal-Fed Hogs.

Number of pigs.	Initial weight.	Closing weight.	Total gain.	Average gain per head per day.	Food consumed.		Pounds of food per cwt. gain.		Total cost of food.	Cost per cwt. gain.
					Beans.	Cornmeal.	Beans.	Cornmeal.		
14	2228.6	3548.9	1320.3	1.52	2683	2683	203.2	203.2	$42.93	$3.25

From the above summaries it would appear that hogs of the weights and ages of those fed in this experiment could reasonably be expected

to make a gain of about a pound per day on a ration consisting of beans only, and that the same sort of hog could reasonably be expected to make a gain of about 1½ pounds per day if an equal amount of corn were supplied with the bean ration. Further, it would appear that the gains made by the bean-fed hogs would cost about $2.50 per hundred pounds and those made by the beans- and corn-fed hogs would cost about $3.50 per hundredweight when these feeds are valued at the prices quoted in this bulletin.

One thing is certain, if the cost of additional labor and equipment is eliminated, the gains from the exclusive bean rations are cheap. But the cheapest way is not necessarily the most feasible way, or the one giving the greatest profit. In order to better ascertain more of the real differences which cannot be made to appear in a simple table of weights, gains and costs, two swine experts of wide, practical experience were asked to look over pens 3, 4, 5 and 6 at the close of the experiment and make a valuation of the same from a market or butcher standpoint. Each man made an independent estimate and the average of the estimates was then taken. Pen 4 was rated 5-16 of a cent higher per pound than pen 3, and pen 6 was rated at 5-8 of a cent higher than the corresponding pen 5.

If again for comparison we assume 5 cents per pound live weight as the value of pens 3 and 5, and give the additional values assigned by the judges to pens 4 and 6, then pen 3 would be worth, at the closing date, at 5 cents per pound, $48.12. Deducting from this the cost of feed—$6.36—there would remain $41.76 to cover original value of pigs, expense for labor, profit, and, in fact, all other items except food.

Pen 4 would be worth $54.82 at 5 5-16 cents per pound; then deducting the cost of food—$11.68—the remainder would be $43.14. Comparing this amount with the similar amount for pen 3 leaves $1.38 in favor of the method of feeding practiced with pen 4, notwithstanding the fact that pen 3 weighed 15 pounds more at starting.

Carrying the same method of estimating through Comparison No. III, pen 5 would be worth, at closing date, $45.83 at 5 cents per pound. Deducting from this the food cost leaves $39.86 to cover the original value of pigs, et cetera.

Pen 6 would be worth $56.94 at 5 5-8 cents per pound. Deducting from this the cost of food, leaves $45.98. Comparing this amount with the similar amount for pen 5 leaves $6.14 in favor of pen 6, notwithstanding the fact that pen 5 weighed 9 pounds more at starting.

The feeding in Comparison I was not conducted at the same time as that in Comparisons II and III, and comparative estimates were not made at the close of that trial, but combining the results from Comparisons II and III there would stand to the credit of the two pens fed on cornmeal and beans $7.52 more than to the similar pens fed on beans only.

PART III.

Notes on Management.

Cooking.—Beans can be fed to swine only in the cooked form. The pig seems to be unable to utilize beans which are at all hard or firm, even though they have been boiled for some time, hence it is very essential that they be thoroughly cooked. To supply a single feed of half-cooked beans to a pen of hogs, robs them of their appetites and relish for their food, if indeed it does not put them off feed. The cooking should be conducted in an even more careful manner than it would be in preparing them for human food. It will materially shorten the cooking period and give better results, if the beans are soaked an hour or two, or better, over night, before the cooking proper is begun.

The amount of water used will be governed somewhat by the way the beans are to be fed, whether they are to be mixed with other feeds or fed alone. In either case the water content of the ration should not be above the bodily requirement of the pigs fed. In fact, it is usually better to have the water content of the ration below the daily requirement of the pig and then allow the pig access to water at will or supply it regularly. When the food is excessively sloppy, the pig is compelled to consume unnaturally large amounts of the ration given in order to properly supply his bodily needs. This distends the stomach, unbalances the whole digestive system and make a paunchy, ill-formed pig, and one which, at slaughtering time, yields a very low per cent of dressed carcass. Such feeding is neither good practice nor good economy.

Two ways for cooking are used here at the College. The one by injecting live steam into a barrel containing the food to be cooked, the other by the use of the ordinary feed cooker, consisting of a caldron kettle with a castiron stove as a jacket for the same. A large variety of cookers of similar sorts are upon the market. In cooking small amounts, the kettle gave the better results, while the steam was more convenient for larger quantities.

Foreign Material.—All refuse grains contains more or less foreign material. Cull beans are no exception to the general rule; perhaps the most objectionable ingredient being the gravel stones. In some samples there was from five to ten per cent of gravel stones. These are not only an annoyance in cooking, but their feeding value must be rated as low as any other possible ingredient. By the use of a hand fanning mill adapted for bean cleaning, a considerable portion of the stones may be eliminated.

Salt.—In the use of salt with pigs to which salt has not been supplied regularly care must be taken to offer it in small quantities at first. When supplied suddenly or in excessive quantities very serious, or even disastrous consequences may follow. Always keeping this caution in mind, it will be found advantageous to use some salt with every mess of beans cooked, about the same amount as would be used for human food would probably be sufficient.

Salt is an appetizer and renders the food more palatable. It also possesses laxative properties and on this account will be found valuable to use in connection with any ration containing beans.

From the use of beans, both with and without the addition of the salt, there seemed to be a greater difference than could be accounted for by the reasons just given for its use. Foster, in the Text-Book of Physiology, speaking of the whole class of salts, says: "Their presence is in some way essential to the various metabolic processes; hence they need to be always present in daily food. In what way it is that they thus direct metabolism we do not know, but we are aware that the properties and reactions of various proteid substances are closely dependent on the presence of certain salts." In the use of the exclusive bean ration which the reader knows has a very high protein content, such marked differences were noticeable with and without the use of the salt that it seemed to those having the work in charge that the salt supplied was a very material assistance in elaborating or metabolizing the large supply of protein which the pigs were receiving. Be this as it may, however, it is certainly an advisable practice to salt all beans which are to be used for swine feeding.

Getting on Feed.—It is a general rule in all feeding operations that when any change is to be made in the ration of an animal it should be done gradually. This is especially applicable in the use of a ration containing any large quantity of beans.

Temperature of Food.—In winter feeding it will be advisable to supply the feed while warm, but in the use of all warm feeds every pailful used should be stirred until at an even temperature and then tested with the finger. It is a cruel neglect to supply hot food to a hungry pig. Sore mouths, dislike of food, and apparent loss of appetite are sometimes traceable to no other cause. Such mistakes will sometimes occur unless the feeder adopts the plan of stirring and testing every pailful fed.

Kettles and Barrels.—Pails used should be rinsed after each feeding and especial care should be taken to clean the kettle or barrel after each cooking and not allow sour or mouldly material to collect about the food receptacle. More than one case of supposed hog cholera has been traced to ignorant or careless neglect in allowing old swill to accumulate in a barrel instead of emptying the barrel each time before the new material is dumped into it.

INSECTS NEW OR UNUSUAL IN MICHIGAN.

BY R. H. PETTIT.

Bulletin No. 244.

INTRODUCTORY.

The present bulletin is written for the purpose of placing on record certain new insect pests that have appeared in Michigan during the last few years, and of noticing recent invasions of old but little known or unusual enemies.

The illustrations are from various sources. Credit is given in each case where the cut is not original.

The methods of preparing insecticides are given in special bulletin number 24, and in bulletin 233, either of which may be had on application.

The writer wishes to thank Mr. E. J. Kraus, Student Assistant, for his aid in rearing several of the species, in making photographs and in many other ways.

We are always glad to receive insects or their work, and in return to name them when possible, and to give advice as to their control. Send specimens, when possible, in tight, tin boxes with few, if any holes. Send to the Department of Insects, or to the Entomologist of the Experiment Station, Agricultural College, Mich.

STRAWBERRY-LOUSE.

(*Aphis forbesi.*)

Plant-lice that feed on the leaves and on the roots of the strawberry.

Of late there have been occasional complaints of root-lice on the strawberry, small green or black lice that appear on the leaf-stems and foliage during late March and early April. Later, about the last of April, the lice are carried underground and placed on the roots of the plants by ants, where they multiply under the care of the latter, until the roots become covered with lice. Many generations are reared during the summer, for the lice produce living young at a rapid rate. Late in the fall, sexual forms appears on the tops, and these deposit large numbers of eggs which are at first orange in color but later become shining black. The eggs are attached to the leaves and leaf-stems and remain over winter, thus providing for the spring crop of lice.

REMEDIES.

Professor E. D. Sanderson, in the 12th, 13th and 14th Annual Reports of the Delaware Experiment Station, insists on the necessity of putting out clean plants on clean ground, free from strawberry-lice and ants. It is poor practice to put out strawberries on land just used for strawberries which were infested; furthermore, land just used for corn or melons is apt to be well stocked with ants, therefore it is well to avoid setting out strawberries on land just used for either of these crops when we have reason to fear root-lice. Land that has been under intensive cultivation is less apt to harbor ants than that which has not been stirred constantly.

The plants themselves can be pretty thoroughly cleaned of the lice if dipped in tobacco-water after the eggs have been hatched, usually about the middle of April. In order to reach all the lice, the whole plant should be immersed. Prof. Sanderson recommends using about one pound of tobacco waste to a gallon of water and boiling about half an hour. He also recommends burning over the infested beds just as growth commences in the spring, producing a quick, hot fire by means of straw. This kills the lice on the crowns and foliage without injuring the plants if done just right.

CUT-WORMS IN BEETS.

About the middle of June, word came from one of the sugar-beet raisers of the state, that cut-worms were devastating the fields. A visit to the region showed the report to be true. Cut-worms were being collected by the gallon and destroyed with kerosene. Many were brought back and placed in our cages, but as they have not, as yet, emerged, it is not possible to name the species with certainty. The worms were large, smoky in color, and nearly full-grown. Many had just pupated beneath the surface of the soil.

In combating the cut-worms, poisoned baits were used successfully. Bran mixed with paris-green at the rate of two pounds of the poison to one hundred of bran and moistened with cheap molasses and water was distributed about the edges of the worst patches of infestation. The effect was noticeable after twenty-four hours, the places where the poison had been used escaping with a fraction of the injury inflicted elsewhere.

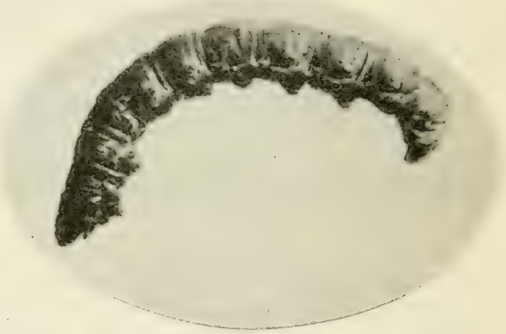


Fig. 1. Cut-worm from Sugar-beets slightly enlarged (Original).

Salt has been recommended for cut-worms by various people but, up to this time, the writer had had very little faith in it, nevertheless, in this case, a heavy top dressing of salt had been applied to part of a field, using from 150 to 200 pounds per acre. The results were very satisfactory, the line between the salted and the unsalted areas being clearly defined. The salt seemed to kill the young worms during their wanderings and to repel the older ones. Just what the effect of repeated sowings of salt on most of our soils would be, the writer can not state, neither is it possible to know beforehand whether this measure would prove beneficial on our soils in general. We can merely state that in this particular instance where the soil was black and full of humus and decaying organic matter, the results were very satisfactory. The writer does not recommend this treatment in general, but hopes to try it out under varying conditions.

During severe cut-worm invasions, a good proportion of the worms are apt to be parasitized, most often by tachina-flies, whose tiny, porcelain-like eggs are to be seen plastered on the skins of the worms. These flies are not unlike house-flies in appearance, and their maggots dwell inside the living bodies of the cut-worms, emerging as adults after the worms have gone into the soil and pupated. Many such parasitic flies were bred from the cut-worms in our cages. As these flies are the natural enemies of the worms, anything which will protect them will

help to kill off the worms, for this reason, all worms that are collected should be placed in tight enclosures, with the open bottoms set into the soil and with openings at the tops covered with screening or netting, having a large enough mesh to allow for the exit of the flies, but not large enough to permit the escape of the millers or moths which come forth from the unparasitized worms.

LITTLE GRAIN-MOTH.

(*Tinia granella.*)

A small moth that bores into seeds and grains, working both in the field and in stored grains.

To the list of Tiniid moths working in grain in our state we must add one more, the little grain-moth or wolf-moth of Europe. It is very small, only about the size of a clothes-moth, but differing in having spotted wings. The ground color is creamy white with a suggestion of pearl, the wings being marked by brown or blackish spots. There is a tuft of pure white scales at the front of the head. The insect measures a little less than a fourth of an inch when the wings are folded. In its work it resembles the Angoumois grain-moth to a decree, tunneling into the kernel of grain of all sorts and binding them together with webs of silk. The larvae also crawl about more or less aimlessly, spinning threads wherever they go and thus fouling more than they eat. The eggs are laid both on grain and on corn in the field, and the pests continue to breed on the seeds after harvest, raising several generations a year. We have received the insect working in field-corn in the cob, where it was the cause of severe losses. We have received it also from Mr. E. J. Kraus, of Lansing, who bred the moths from larvae found tunneling in corn-stalks which had been stored in a barn over winter. The determination in both cases was verified by Mr. F. H. Chittenden of our National Bureau of Entomology. We have also bred what appears to be the same species from drying fungi (*Morchella*) here at the Agricultural College.

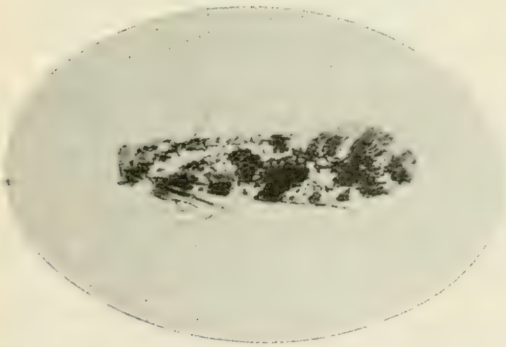


FIG. 2. Little Grain-moth, greatly enlarged (Original).

REMEDIES.

The habits of this pest render it difficult to eradicate, but fortunately it is not so very widespread as yet. No better remedy suggests itself than that recommended for the Angoumois grain-moth—fumigation with carbon-bisulphide or possibly with some other agent.

FIG. 3. Work of little Grain-moth in field corn, slightly enlarged (Original).

MEDITERRANEAN FLOUR-MOTH.

(*Ephestia kuehniella.**)

A small moth, the larvae or caterpillar of which spins webs in flour-mills, clogging the machinery and felting the flour.

Something more than fifteen years ago, an insignificant little moth appeared in this country, and since that time it has spread over a good part of America, from California to New York and Pennsylvania, here and there—Minnesota, Alabama, Colorado, North Carolina and Canada have suffered. During the past year the creature came to light in our state.† It was expected, of course, being bound to arrive sooner or later. The appearance of this little creature is very deceptive, something less than half an inch long; and under an inch, when measured from tip to tip of the extended wings, of a dull-gray, leaden color, and very delicately built. The creature appears incapable of bringing about such wide-spread havoc. The injury is caused by the larvae or caterpillars, not so much because of the food that is eaten as by the habits of spinning silken threads wherever they go.

The figure gives a very good idea of the appearance of the creature. The small white caterpillar has the head and part of the first thoracic segment light brown. There are five pairs of false-legs beside the six true, jointed legs of the anterior region. These larvae travel everywhere, through the flour and sometimes in the grain, spinning very fine silken webs which felt the flour together and make it lumpy. They

* This identification was kindly verified by Mr. F. H. Chittenden of the National Bureau of Entomology.

† Since writing the above, the writer has received information from Mr. F. H Chittenden of the National Dept., who states that on July 5th, 1902, he received specimens of this species in flour from Michigan.

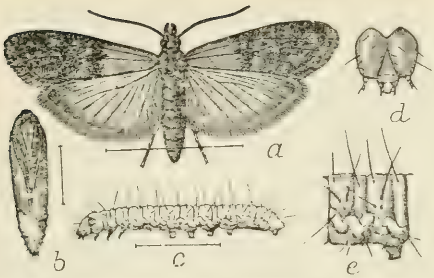


FIG 4. Indian-meal moth, enlarged, after Chittenden, Bureau of Ent., U. S. Dept. of Agr.

also spin silken galleries all through the elevators, spouts, bolting machinery and everywhere else, being especially troublesome at the times when they are seeking good quarters for spinning up. Such quarters being found, they spin tough, white cocoons, about half an inch long or less, inside of which the slender brown pupae are formed. From these the moths issue later and lay large quantities of eggs.

The fact that only two months or less are required for the creature to complete its life cycle, makes it possible for it to multiply at an astonishing rate. The modern steam-heated mill lends itself very nicely to the needs of this creature, which is partial to warmth and darkness.

The Mediterranean flour-moth resembles superficially another moth, the Indian-meal moth (*Plodia interpunctella*) which is scattered fairly well over the country. The latter seems to prefer whole grain to flour when there is a choice. It binds the kernels together by means of threads. The insect feeds on a great variety of dried vegetable products and is apt to be found in mills. The moths are readily distinguished from those of its Mediterranean relative, the front-wings being light grey in color for about one-third of the distance and darker brown for the remainder.

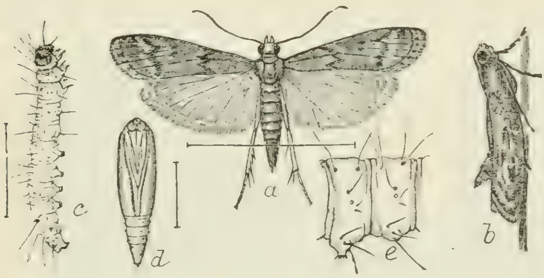


FIG. 5. Mediterranean Flour-moth, enlarged, after Chittenden, Bureau of Ent., U. S. Dept. of Agr.

REMEDIES.

Three methods suggest themselves for the control of this insect. First, the substitution of metal for wood wherever possible. Metal spouts are less likely to become clogged than those constructed of wood. They are more easily kept clean and the moths do not like them so well. Second, fumigation with carbon-bisulphide or with hydrocyanic-acid gas has been recommended by several who have had to deal with the pest, but the first named is extremely dangerous if breathed and extremely explosive if a spark or fire in any form be brought to it. Heat, even in a considerably less degree than that required for the combustion of wood, will explode the gas when mixed with air, as it is used in fumigating. It is also quite likely to make trouble with the underwriters if any loss occurs while it is in use at least. Hydrocyanic-acid gas is also extremely dangerous. A single breath of the gas of the strength used is sufficient

to produce instant death.* This latter method is recommended, however, by such men as W. G. Johnson, formerly State Entomologist of Maryland, and by Professor F. L. Washburn, Entomologist of the state of Minnesota, who have both used it.

The use of the gas generated by burning sulphur, for this purpose, has not been tried enough times to give us much confidence in its efficacy. When used at all, it should be employed at the rate of at least three pounds of the sulphur to one thousand cubic feet of space inside the mill, and everything about the building should be tightly closed. The danger from its use is that of corroding metals and fabrics, besides injuring any flour which may be present. The fumes unite with the moisture from the air and produce sulphuric acid finally, or oil of vitrol, which acts on all sorts of substances, but more especially on metals. For this reason, it is necessary to have the air as dry as possible if the injury is to be reduced. It is hoped that some method of using sulphur or something else will be perfected soon, which will be just as good and safer than either the carbon-bisulphide or the hydrocyanic-acid gas.

In any case, when fumigating, it is expedient to run the stock as low as possible to avoid exposing it to the gases, and to make it easier for the gases to penetrate to all crevices, corners, etc. Hydrocyanic-acid gas must be generated by means of strings or other contrivances from the outside, and the several floors must be kept shut off from each other when using either the hydrocyanic-acid gas or the carbon-bisulphide, because of the difference in the weight between them and the air. The building, in any case, must be made tight and everyone excluded during the fumigation and for half a day after the building is opened and ventilated. It is also necessary to open the ventilators or windows from the outside, preferably by means of ropes, in order to avoid danger at that time. No fires, either in the building or nearby, are admissible, for the gas from carbon-bisulphide may be carried out through a crack and exploded. Sulphur is apt to corrode metals, it is true, but hydrocyanic-acid gas has been known to do so to a degree. Anyone using either carbon-bisulphide or hydrocyanic-acid gas should familiarize himself thoroughly beforehand with all details and bear in mind that he takes a good deal of responsibility upon himself in any case.

The third method is that of chilling. Many of the pests are killed by the simple expedient of opening up the mill and leaving it open for about three days during zero weather. It is suggested, by Mr. F. H. Chittenden, of the Bureau of Entomology, that perhaps chilling on alternate days for a week might prove even better than if it were done all together. This might interfere a little less with the milling operations, and might possibly kill more of the insects than one prolonged chilling. If chilling is practical, it will be necessary to select zero weather, for mere freezing will not be sufficient. Of course, all water or steam pipes or receptacles must be emptied to prevent bursting.

Finally, plenty of light and frequent and thorough cleaning will aid materially in keeping the pest in check.

* The manner of generating and applying these gases is discussed thoroughly by W. G. Johnson in his book "Fumigation Methods."

GREENHOUSE LEAF-TYER.

(*Phlyctaenia rubigalis.*)

A small Tiniid larvae or green "worm" that feeds on the leaves of greenhouse and forcing-house plants, tying them together into nests.

This destructive creature has already appeared in several widely separated greenhouses in Michigan, and, no doubt, will appear in others. It feeds on a long list of greenhouse and forcing-house plants. Professor M. V. Slingerland records it on most soft-leaved greenhouse plants, especially on lettuce, sweet-peas, clover, parsley, cinerarias, chrysanthemums, geraniums, strawberries and cucumbers. Others record its work on tobacco (in hot-bed), carnations and violets. In our state the most injury has been done to chrysanthemums, although many other plants have been attacked.

When sitting on the plants, the moths present a triangular outline, the wings being raised slightly along the middle line. The color is yellowish-brown with a tinge of rust, the front-wings being darker than the hind-wings and marked by inconspicuous darker, transverse, wavy lines. The moth is a little less than half an inch in length.

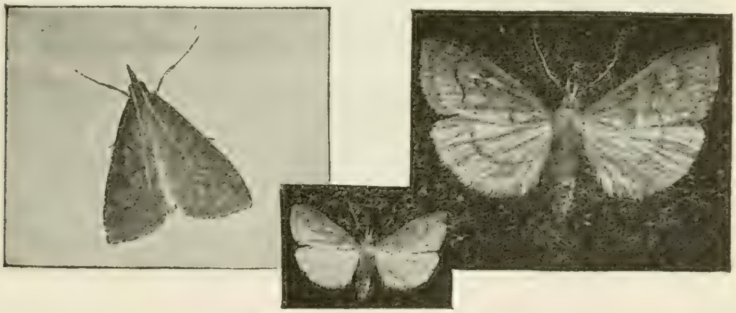


FIG. 6. Adult of greenhouse Leaf-tyer, after Slingerland; natural size in center below.

The eggs are oval and flat, greenish-golden in color and opalescent. They are usually laid close together in small clusters. The larvae are about five-eighths of an inch in length, very lively, and in color, green. They are marked by three longitudinal stripes, a darker green one along the middle of the back, and a lighter stripe on each side of the median one.

The damage is wrought by the larvae which eat the tissue in patches, usually from the underside of the leaves, leaving the skin on the upper surface intact. In thin leaves, like lettuce, they are said to devour the entire leaf. As the larvae grow, they bind together and curl some of the leaves, more often the smaller ones, making nests in which they change to pupae, inside of small white cocoons. Professor Slingerland,* in his exhaustive discussion of this creature, says that seven or eight

* Bulletin 190 Cornell University Experiment Station.

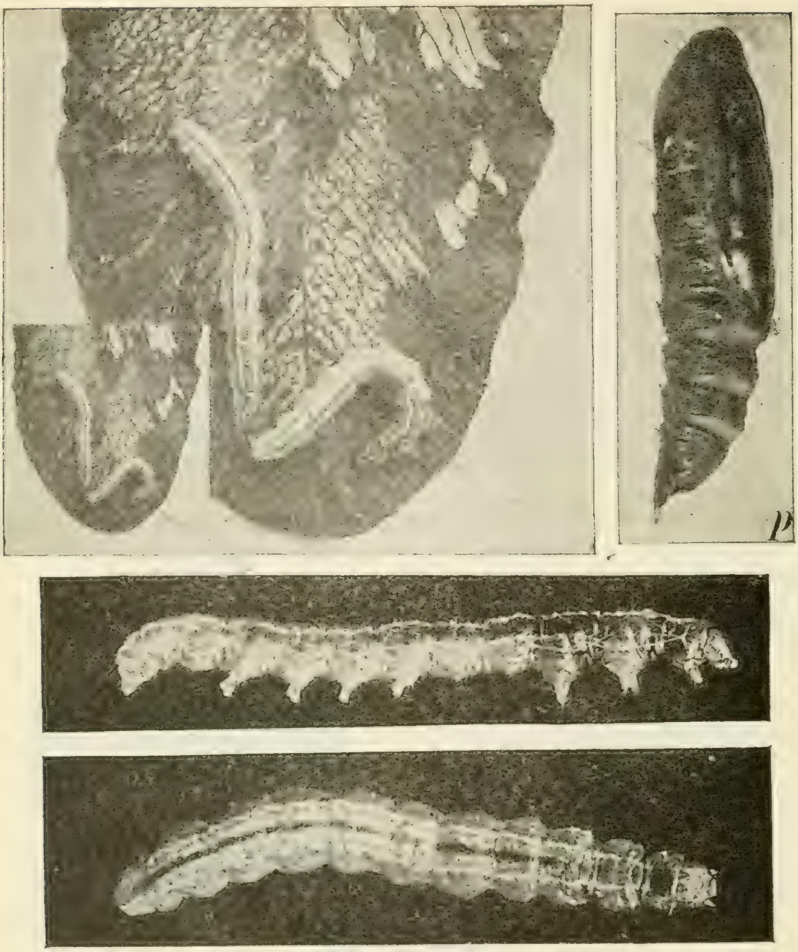


FIG. 7. Greenhouse Leaf-tyer, Slingerland. Caterpillar on skeletonized leaf above natural size and enlarged; larvae and pupae much enlarged.

generations may occur in greenhouses, and Professor Forbes* thinks that four generations out of doors are not too many. The greatest damage, however, is done under glass.

PALLIATIVE MEASURES.

Thus far nothing better than constant watchfulness and the destruction of the larvae and pupae by hand, has been discovered. Fortunately the work is usually in plain sight and conspicuous.

* Bulletin 60, Illinois Experiment Station.

WHEAT-MIDGE.

(*Diplosis tritici.*)

Minute reddish maggots, inside the flower or next the kernel of wheat, which maggots deform and shrivel the berry.

As long ago as 1874, Professor Cook, then of this station, records the presence of the wheat-midge or red weevil, and since that time we have heard of its presence here and there in restricted areas. Last year it appeared here at the College, in sufficient numbers to attract attention.

FIG. 8. Wheat-midge, greatly enlarged, from photo, 26 July, 1906 (Original).

The larvae of the wheat-midge are very small, and several may inhabit a single flower of wheat. The eggs are laid by tiny, yellowish flies on the glumes or chaffy envelopes of the flowers. The maggots travel down into the region about the forming seed, where part of the juice of the young kernel is extracted in some way, the result being seen in the shriveled grain when threshed. The heads are also poorly filled, and when the midges are plentiful, the result is very disappointing. There is usually but one brood each year, although there is reason to suspect the presence of a partial second crop of the adults at least.

When full-grown, the larva descends to the ground and buries itself under the surface. The descent is often aided by rains, which wash out the tiny creatures and carry them down, others, no doubt, drop and wriggle their way down. During June of the following year the flies come forth and lay their eggs. Wet weather and warmth favors their increase, while cold, dry weather proves unfavorable.

FIG. 9. Wheat-midge, photo-micrograph, 27 Nov. 1906 (Original).

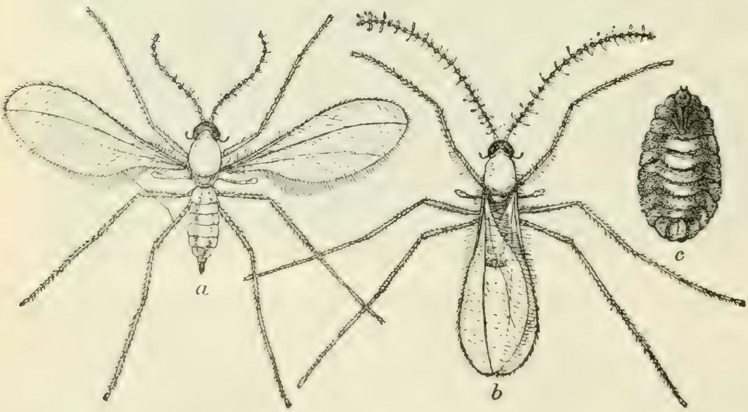


FIG. 10. Wheat-midge, much enlarged after Marlatt, Farmer's Bulletin 132, Bureau of Ent., U. S. Dept. of Agr.

REMEDIES.

Deep plowing of the stubble, after harvest, buries the larvae and kills a large proportion of them. The larvae and pupae are, however, very tenacious of life. Many fail to descend to the ground in time and are carried to the barn with the chaff. For this reason all chaff should be burned after an invasion.

RASPBERRY BYTURUS.

(*Byturus unicolor.*)

A small reddish-brown beetle that feeds on the buds and flowers of raspberry.

For the first time, so far as is known to the writer, the raspberry byturus has appeared in injurious numbers in our state. No doubt it has been with us before, but has not heretofore been sent in. This tiny creature is about one-eighth of an inch long, reddish-yellow in color and covered with a dense coat of short, yellowish hairs. The beetles feed on the buds of raspberry as well as on the opening flowers. They seem to prefer the stamens, containing the pollen, but also partake of

Fig. 11. Raspberry Byturus, greatly enlarged (Original).

other parts of the buds. In any case, the buds are so injured that if some of them do manage to develop into fruit, the fruit is so disfigured as to be of no value. The larvae are said also to be found inside the fruit of red raspberries. When full-grown, the larvae drop to the ground and form little cells in the soil, usually under rubbish or some other material, where they change to pupae and then to adults the following spring, ready to attack the raspberry buds in May.

REMEDIES.

The arsenicals suggest themselves at once as proper applications, and of all of them, arsenate of lead seems most likely to be successful, as it can be applied in heavy doses with no danger of injury to the plants, remaining also on the buds longer than anything else. Use it quite strong and apply when the beetles first appear, before the buds are open.

STRAWBERRY ROOT-WORM.

(*Scelodonta nebulosus.*)

Small metallic green beetles that feed on the foliage of strawberry and grape, and the larvae of which feed on the roots of strawberry.

Three species of strawberry root-worms occur in states just to the south of us. The larvae of all these closely resemble one another, both in appearance and in habits. One of these has been with us many years. It was noticed in special bulletin No. 24 and in bulletin 180 of this station, under the name of *Typophorus canellus*. and in the Report of the Michigan State Board of Agriculture, by Professor A. J. Cook, under the name of *Paria aterrima*. Another of these root-worms has made its appearance in injurious numbers. This one is known as *Scelodonta nebulosus* and was reported once before from Michigan, a single specimen having been sent to Professor Forbes, State Entomologist of Illinois, in 1884. It is only about an eighth of an inch in size, bronzy-green in color, with a thin covering of whitish hairs. The beetle is quite robust and is highly polished underneath the hairs. The larvae of all these beetles resemble tiny white-grubs and feed on the roots of strawberry.

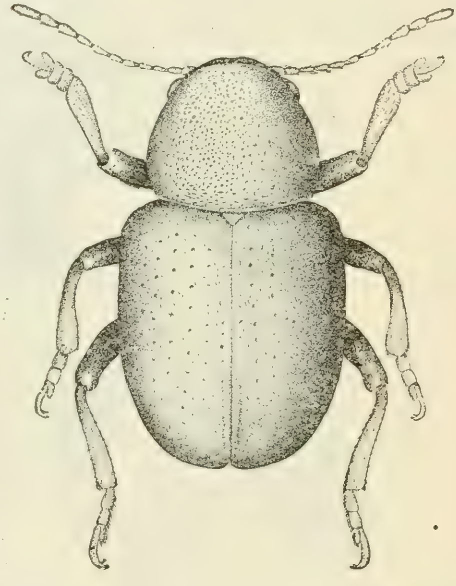


Fig. 12. Strawberry Root-worm, much enlarged from S. A. Forbes, XIII Rep. State Entomologist of Illinois.

On August 8, 1904, we received a lot of these beetles from Glen Lord, Berrien County, sent us by Mr. F. W. Lee. Mr. Lee reports them as having destroyed about five hundred young grape-vines by feeding on the foliage.

REMEDIES.

When the adult beetles are feeding on the leaves, there should be little difficulty in killing them with a spray of arsenate of lead, of course avoiding such a spray if the fruit be far advanced or if the plants be in bloom. The larvae can usually be taken care of here in Michigan by killing the adults and rotating, although in very bad cases it may be necessary to plow in the fall. In places where the grubs work year after year, plants should be dipped in tobacco-water before setting. They should also be set in soil not too near the old beds and soil which is not already stocked with the pests.

THE FOUR-SPOTTED BEAN-WEEVIL.

(*Bruchus quadrimaculatus.*)

A small beetle, resembling the common bean-weevil, which works in cow-peas and in beans.

We must add one more species to the list of pests feeding on stored seeds in Michigan. While the insect has been found in but one locality thus far, it is likely to be more generally distributed as time goes on. The four spotted bean-weevil is well known in the South to work on cow-pea by preference. It will also feed on table bean on occasion. Our experience has been limited to its work in cow-pea. In general appearance the beetle is not unlike the common pea-weevil. It is larger than the bean-weevil, but not so large as the pea-weevil. The general color is brown, sometimes chestnut-brown the wing-covers with four dark spots, the rear pair of which often fuse together, making the entire rear end dark-brown. There are a pair of light-colored, elongate dots of light gray or white hairs just in front of the bases of the wing-covers on the middle line; in other words, in front of the scutellum. The figure, which is from bulletin No. 8, N. S., of the Bureau of Entomology, U. S. Dept. of Agriculture, shows well the appearance of the creature. The bulletin cited contains an extended account of the creature by Mr. F. H. Chittenden.

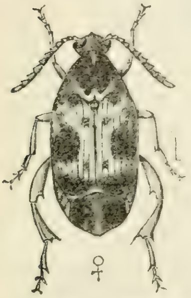


Fig. 13. Four-spotted Bean-weevil, enlarged, after F. H. Chittenden, Bul. 8, N. Ser., Bureau of Ent., U. S. Dept. of Agr

The work of this creature, like that of the bean-weevil, is said to commence in the field, and in this way the beetles get into the stored cow-peas, where they continue to breed. In our specimens the rule was one beetle to a pea, although two were not very uncommon. The creamy, almond-shaped eggs were thickly plastered over the skins of the peas.

A careful search was made of all the cow-peas in the building and all suspected material was fumigated in hopes of killing off the entire colony before it spread.

REMEDIES.

Fumigation of the seed, during a warm spell, using carbon-bisulphide in the regular way described in bulletin No. 233 of this station, should kill all the active beetles, and a second treatment, after a period of warm weather, should complete the work, if indeed, the first does not suffice.

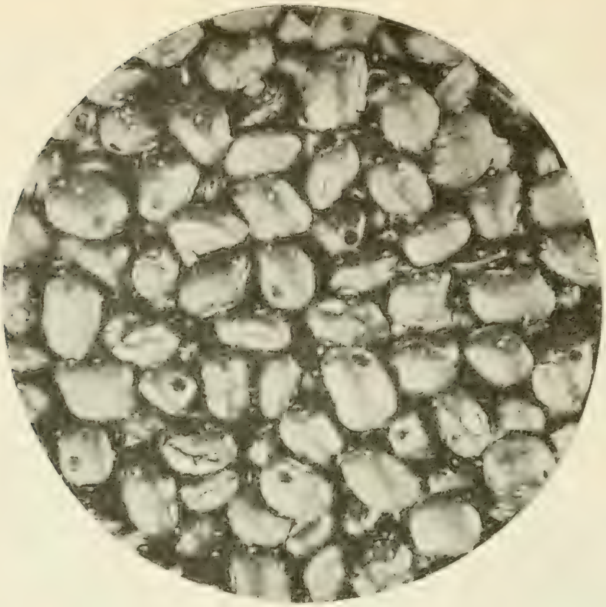


FIG. 14. Work of four-spotted Bean-weevil, on cow-pea, slightly enlarged (Original).

POWDER-POST BEETLES.

(*Lyctus* spp.)

Small beetles that tunnel in the sap-wood of timbers, either in the log, board or in floors, frames or finished furniture.

The steadily increasing scarcity of good heart-wood for building purposes, has led to occasional loss from powder-post injuries. Thus far the reports of injury have been mostly confined to injury done to flooring, probably for the reason that in flooring the work is more conspicuous than in other parts of house construction. The agents that cause the trouble are small beetles which tunnel through the sap-wood, excavating it more or less completely and occasionally coming to the surface where small heaps of fine, flour-like waste are thrust out. These little heaps usually lead to the detection of the pests. Further investigation leads to the discovery that the wood is pierced by small tunnels, sometimes so profusely that little of the original stock remains except the outer shell and some fibres, extending here and there, inside. The work of these creatures is well known further South and is perpetrated by several species. We have been unable to obtain perfect specimens of the culprits in Michigan, owing to the fact that their depredations have been in finished oak and maple wood-work, where it was not desirable to cut out pieces for splitting, but fragments of the beetles which have

been dug out, lead us to believe that the beetles belong to a genus, the members of which are known to be engaged in this kind of work elsewhere, viz., *Lyctus*.*

REMEDIES.

Dr. A. D. Hopkins, of our National Bureau of Entomology, discusses these insects in Circular No. 55, which may be had on application. He advises, when the beetles are once established:

1. A liberal application of pure kerosene, benzine, gasoline, formalin, brine, or like substances, to the infested parts.
2. Thorough steaming of the wood in a tight room.
3. Subjecting the wood to the highest practicable dry heat in a dry-kiln.

"In the case of finished products, such as furniture, museum specimens, and the like, which are portable, they may be subjected to the treatment mentioned under "1," "2," and "3," selecting the one which is least injurious to the articles. In the case of painted or varnished articles which would be injured by external treatment, the liquid may be injected into the holes made by the insects, or in small gimlet holes made for the purpose, to be afterwards filled with putty. With inside hardwood finishings, such as wainscoting, staircases, floors, doorposts, and the like, the injection of the liquid is perhaps the only practicable method of checking the progress of the injury."

"When infested construction timbers are badly damaged, or important parts are weakened by the work of the insects, they should be removed and replaced by sound heart-wood material, while all slightly damaged accessible wood should be treated with an external or internal application of a suitable liquid remedy."

Dr. Hopkins also gives advice as to methods of keeping the pests out of lumber yards, etc., and calls attention to the fact that it is in sap-wood only that the beetles work. The lesson is obvious—if buildings are constructed free from sap-wood, there is no danger from powder-post.

STRAWBERRY CROWN-GIRDLER.

(*Otiorhynchus ovatus.*)

A small white-grub which feeds on outer edge of crown of strawberry.

As long ago as 1883, Professor C. M. Weed, then instructor in the Michigan Agricultural College, published an account of this insect, reporting it as destructive to strawberries here at the College. Since that time we have heard comparatively little about it until recently, nor do the recent reports speak of the trouble as of a very serious nature, the

* In this connection we may mention that we have obtained Lyctus unipunctatus from Hillsdale, Mich., collected, 5 June, 1900, tunneling in dead and dying grape canes. Mr. G. C. Davis also records the same species in a red oak floor here at the Agricultural College, in 1891.

specimens having been sent in more out of curiosity than for any other reason. One lot of the larvae was sent in from outside the state, which enabled us to obtain photographs of this and the pupal stage, and later of adults bred from the same lot.

FIG. 15. Strawberry Crown-girdler, enlarged (Original).

The work of these pests is, for the most part, done to the outer part of the crown of the strawberry. They, no doubt, feed on other plants also, but their work on strawberry seems to result in the only injury of consequence. The larvae do their work late in May and early in June. When full grown, the larvae make little cells in soil where they pupate, later changing to adult beetles, which come forth about the middle of July. The larvae look like minute white-grubs, being usually less than one-fourth of an inch long and curved into a segment of a circle. The white pupae are about the same size, but show the shape of the forming legs, wings, etc. The adults are snout-beetles, dark brown or almost black in color, with small head and thorax and broad ovate abdomen; they are less than one-fourth inch long.

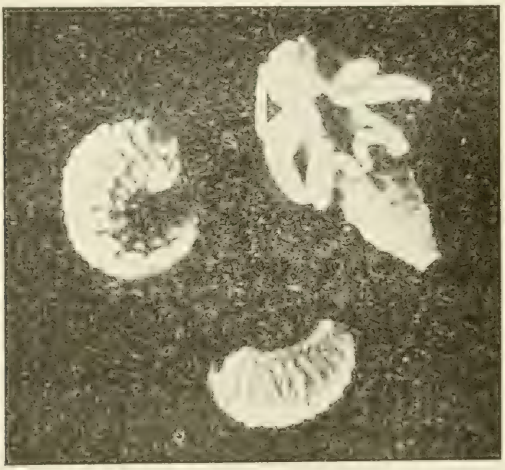


FIG. 16. Strawberry Crown-girdler, larvae and pupae enlarged (Original).

During the late autumn, the adult beetles are to be seen congregating about buildings, often crawling up the foundation walls.

REMEDIES.

Very few experiments have been tried looking to the control of this beetle, owing to the infrequency of infestations. Plowing about the first of June should bury the larvae and pupae so that few would escape.

STRAWBERRY WEEVIL.

(Anthonomus signatus.)

A tiny beetle that punctures the flower-stems of strawberry and blackberry, causing the buds to droop and die.

On two previous occasions Michigan has sustained attacks by this tiny beetle, once in 1883 and again in 1888. The trouble appeared once more in 1905, this time at Arcadia. Specimens were sent in on June 10 by Mr. H. E. Gilbert, whose blackberries were suffering. The beetle itself is a small snout-beetle, a little less than one-eighth of an inch in length exclusive of the long snout. It is chestnut or black in color with a dark spot on the outer part of each wing-cover and with a distinct white, round dot between the bases of the wing-covers. The beetle is believed to produce but one true generation each year, but its work is somewhat prolonged, being perpetrated at first on strawberry and later on blackberry buds.

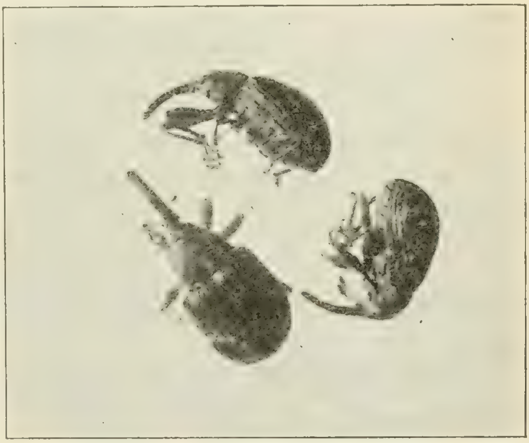


Fig. 17. Strawberry weevil, greatly enlarged (Original).

The adult beetles, which hibernate or pass the winter hidden away in out-of-the-way places, attack the full-grown buds for the purpose of egg laying. The injury is brought about by their habit of puncturing or partially eating away the delicate stems just beneath the buds, thus stopping all growth and causing the buds to dry up and many of them to drop off. After providing for the death of the buds the beetle deposits an egg in each one, and here is found just the right condition for the development of its larva. The larva feeds, for the most part, on the pollen contained in the stamens in the buds and in due course changes to a pupa and finally to an adult, emerging in late June or in July.

These little creatures attack not only the stawberry, but also both wild and cultivated blackberries; they are said to feed likewise on brambles, which are close relatives.

REMEDIES.

As has been stated, the beetles pass the winter in hibernation, usually under rubbish, therefore the advantages of clean culture and the burning

of rubbish over wide areas at once becomes apparent. The destruction of all brambles, wild blackberry and wild strawberry plants would also help to check the trouble. The preference of the beetles for the staminate or pollen-producing varieties of strawberry suggests another method of attack in regions where the beetle is often troublesome. Mr. F. H. Chittenden recommends planting early, staminate varieties at the sides of the fields for the purpose of trapping the pests.*

The arsenicals have thus far proven of little value, owing to the fact that the only time when one can reach the pests is during the puncturing of the bud or the cutting of the bud stem. It would seem, however, that a thorough spraying with arsenate of lead at that time might prove efficient, using four or five pounds to a barrel of water. This would have the additional effect of lessening the depredations of rose-beetles. Kerosene-emulsion is said to repel some of the beetles. Any spray should be put on as soon as the work of the beetles becomes apparent, as shown by the drooping or severed buds, and before blooming.

CABBAGE CURCULIO.

(*Ceutorhynchus rapae.*)

Small gray snout-beetles that feed on cabbage leaves and tunnel in the leaf-stems.

This erratic little pest deserves brief mention. It is an insect capable of producing dire havoc, but only on rare occasions does it live up to its possibilities. In 1876, or thereabout, it was reported by Professor A. J. Cook, at that time of this station, as having been found at Adrian and at Lansing. Since that time it seems to have failed to attract attention in our state until 1902, when it appeared at Charlotte on the 12th of July, when it was reported as destroying late cabbages.

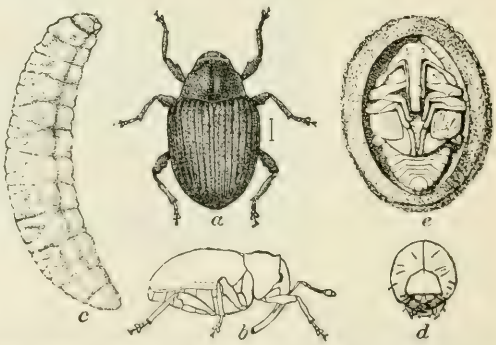


FIG. 18. Cabbage curculio, enlarged, after Chittenden, Bul. 23, N. Ser., Bureau of Ent., U. S. Department of Agriculture.

The method of attack is described by Mr. F. H. Chittenden, in bulletin No. 23 of the U. S. Bureau of Entomology. They appear early in the spring and lay their eggs in wild plants of the mustard family. Here the grubs feed and produce adults before the middle of June. They seem to prefer hedge mustard to cabbages and cauliflowers, but when the supply of mustard is limited, they will attack the latter. There is supposed to be but one generation each year.

*Insect Life, Vol. VII., pp. 14-28.

Our correspondent, Mr. C. F. Cushing, reports that "They get inside of the leaves at the center which they eat up, thus preventing the plants from heading." The beetle itself is a small, robust snout-beetle of gray color; it is only one-eighth of an inch long and is broad proportionately. The ground color is black with a dense coat of light-gray hairs. Extending from the head to the wing-covers is a conspicuous furrow.

REMEDIES.

One hesitates to recommend leaving a mustard plant in a cultivated field for even an hour, but when such plants are to be found and this beetle is known to be present in dangerous numbers, it may be well to delay pulling and burning the mustard in the near vicinity of cauliflowers and cabbages until the middle of June, at a time when the eggs and larvae should be in the weeds here in Michigan. On no account should wild mustard be allowed to seed, for it is so much worse than the beetles that the remedy would be worse than the disease. Fortunately the worst attacks occur while the plants are young and before they commence to head; at such times a spray of paris-green, applied in the ordinary way, will prove beneficial.

Rotation suggets itself immediately as does also the use of commercial fertilizers for their tonic effect.

WHEAT JOINT-WORM.

(*Isosoma tritici.*)

Small white-grubs found in the wall of the stem of wheat usually near the lower joints. They prevent proper ripening and filling of the grain.

Next to the Hessian-fly, the joint-worm is the worst enemy of Michigan wheat growers. Not alone is it destructive to the wheat itself, but its work so resembles that of the Hessian-fly that there is constant confusion between the two species. This is all the more unfortunate because practices that favor the destruction of the one, may have no beneficial effect on the other. The failure of late sowing, for instance, when used to control the joint-worm under the supposition that it is the fly, tends to throw suspicion against the method when it would really be of benefit in its own proper place. The work of the joint-worm differs quite materially from that of the Hessian-fly, although the seat of the trouble is, in both cases, above the joints. In the case of the joint-worm it may be seen above any or

FIG. 19. Wheat Joint-worm, much enlarged, after Marlatt, Farmer's Bul. 132, Bureau of Ent., U. S. Dept. of Agr.

all the joints from the top to the bottom. In the case of the fly, the injury is due to the presence of maggots and flax-seeds between the true stem and the leaf-sheath. The joint-worms burrow inside the walls of the stem itself, causing it to become swollen and full of cavities and to take on a woody structure toward maturity. Fig. 23 shows a characteristic straw, the swellings showing the number of little cells present. Each cell contains a tiny larva, which later changes to a pupa and later to an adult, winged, wasp-like creature of very small size. This adult pierces the straw of a growing young wheat plant and deposits her eggs for the next generation.

The thickening of the straw interferes, of course, with the proper filling out of the head and also renders the straw brittle. While wheat attacked by joint-worms is not so likely to lodge as that harboring the fly, it is apt to produce shriveled berries, often cutting down the yield very materially. None of the varieties which we have examined seem to be resistant to the attacks of the joint-worms, and in our plots we have examined over a score of different varieties.

One brood each year is the rule, the eggs being laid in the young growing plants, and the winter being passed in the cells made in the straw.

Fig. 20. Wheat Joint-worms; pupae in straw enlarged (Original).

Often the first intimation of trouble that the farmer has, is when he discovers that the wheat is shriveled after threshing. He may blame it to rust, or he may notice quantities of short sections of woody straw which fall out by themselves, and which may cause him to question the matter further. These short sections of woody straw are quite characteristic of joint-worm work, and to the experienced eye immediately point to the cause of the trouble.

The adult insect that comes out in the spring, is a member of the order of wasps, but so small that it would take a number to bulk as large as a mosquito. The color for the most part is black. There are four wings, and in the place of the sting is a slender tool for laying the eggs. If it so happens that young wheat plants are accessible when the adults emerge, they are immediately utilized as repositories for eggs.

FIG 21. Wheat Joint-worm; sections of straw broken out by thresher, natural size (Original).

REMEDIES.

Starting with the knowledge that there is but one brood a year, and remembering that the winter is passed in the straw or in the woody segments that are broken out, we should not expect to find any very

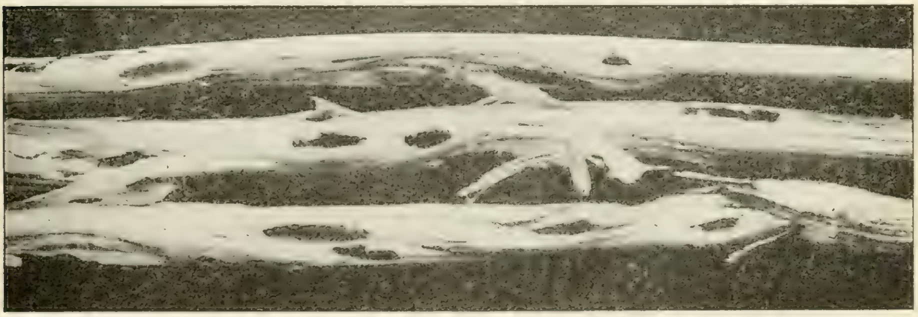


FIG. 22. Wheat Joint-worm, showing where insects have been extracted, probably by mice, enlarged* (Original).

* Fig. 22 shows the appearance of straws which have been searched out by mice or shrews in the barn where the straw was stored. The immature joint-worms have been neatly cut out and eaten. Large numbers of such straws were to be found here this fall.

The most prolific source of infestation is the practice of fall, top dressing with fresh barn-yard manure before wheat. This furnishes the ideal great difficulty in devising practices to at least modify the difficulty. conditions from the standpoint of the insect. Furthermore, top dressing near a field of young wheat offers very slight difficulty to the insects, for they are good fliers if small. The best practice of all is to let the manure lie until spring and to get it thoroughly soaked with the liquids of the stable, and then to plow this under not too near the wheat field. When joint-worms are present in very large numbers it is well to avoid keeping over more straw than is necessary for bedding or which will be used up in other ways before spring. Always burn the short woody segments which contain immature larvae and pupae. When using straw from infested fields, plow deeply if in the fall and harrow in the spring,

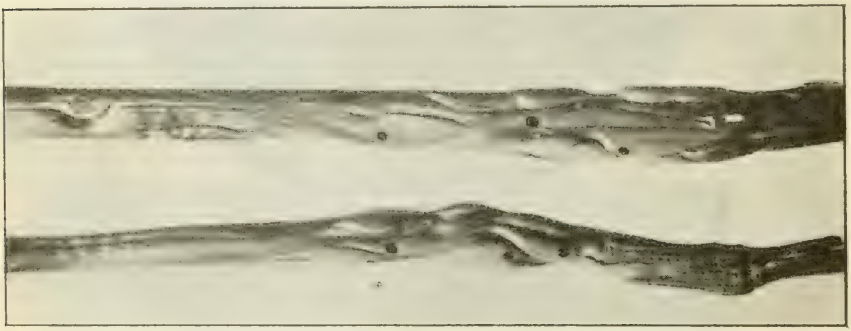


FIG. 23. Swellings made by wheat Joint-worms in straw; enlarged (Original).

for the little creatures can get out unless well covered.

Place new wheat fields at a distance from the old ones and plow directly after harvest unless seeded with clover.

Be sure to differentiate between the joint-worm and the Hessian-fly for the treatment of the two pests is not identical by any means. If there is room for doubt, send in specimens to the writer.

POULTRY RAISING.

BY JAMES G. HALPIN.

Bulletin No. 245.

INTRODUCTION.

There has been a constant demand throughout the State, from beginners in the poultry business and others, for information relating to poultry raising. This bulletin has been prepared expressly to meet this demand. The aim is to make a presentation of the subject in as practical a manner as possible, dealing only with the most elementary problems. At the present time, however, plans are being developed and experiments conducted to investigate the more intricate problems, many of which the individual producer has neither the facilities, time, nor means to solve. During the present year the poultry division has been reestablished with new buildings, colony houses, brooders, yards and other equipment, as shown in illustration number one. The poultry house proper consists, at present, of a building 15x84 feet with a 4-foot alley along one side and seven pens each 12 feet wide. Each pen is intended to accommodate from twenty to twenty-five breeding fowls. The building has been so planned and located that further additions, which even now seem desirable, can be easily made. The incubator house 18x36 feet has a half basement with capacity for operating from ten to fifteen large machines. The floor above is intended for instruction, demonstration and experimental purposes.

SELECTION OF PARENT STOCK.

HEALTH AND VIGOR ESSENTIAL.

In order to obtain fall and winter eggs we must have stock produced from the eggs of healthy, vigorous fowls. A fowl which has suffered, or is suffering from disease, should not be allowed to produce offspring. Although, in some cases, chicks from the eggs of unhealthy fowls succeed in getting out of the shell in fairly good form, in the end they almost invariably prove unsatisfactory. It is fortunate that the eggs from diseased fowls are seldom fertile, otherwise there would be more unthrifty birds in existence. The offspring from a "roupy" hen is not

likely to inherit this disease, but is liable to have a weak constitution and thus fall an easy prey to roup or some other malady. Small, lazy, worthless individuals in the flock are usually from parent stocks which have been affected by disease. One of the first things to do then is to discard all fowls that are not strong and healthy.

PROPER FOOD, EXERCISE, ETC.

In order to have a healthy, vigorous flock they must be provided with the proper amount and variety of food, plenty of fresh, clean water, good pure air, and exercise when under confinement. It is not our purpose to enter into a discussion of feeding here, but merely to say that fowls should have a variety of grains, fed regularly, with proper care as to quantity. Exclusive rations of corn should not be expected to produce eggs that will hatch vigorous, thrifty chicks. But good results should be secured from a mixture of grains, such as corn, wheat and oats, fed in connection with a mash feed composed of such materials as bran, middlings, corn meal and beef scrap, to which green food is added unless the fowls have access to a grass range. If the range supplies a good many insects the beef scrap need not be fed. Judgment must be used, as no absolute rule for feeding can be given. Owing to the freedom fowls enjoy in and about the farm yard and the great variety of suitable food secured, there is less necessity for the purchase of commercial foods on the farm and the formation of highly artificial ration, than in the case of the village or town producer.

SELECT NATURAL AND WELL DEVELOPED PRODUCERS.

A hen suitable to become the mother of the future laying stock should be a good producer herself, and one fed to stimulate production. Among all classes of domestic animals we find some that are naturally prolific, while others in the same flock or herd possess this quality in greatly varying degrees, a few being absolutely sterile; the same is true of poultry, some hens are abundant layers, while others equally well fed and cared for are almost worthless. The prolific layer is the one that should be saved for the parent and fed to lay, as we believe that a hen which has been fed and stimulated to lay a large number of eggs is more likely to produce offspring possessed of the same quality, than one equally well fitted by nature to produce, but which, owing to poor care or neglect has not laid many eggs.

EARLY LAYERS.

Frequently a pullet starts laying before the others and continues to lay well all the year; such a one should be carefully watched and her eggs saved, providing sufficient size was attained before she began laying. Other pullets will lay a few eggs in the autumn and then cease until spring; these should, of course, be discarded. Those that begin laying prematurely are not desirable, as they should attain the size characteristic of their breed before commencing, and then lay continuously during the rest of the fall and winter. Pullets of the smaller breeds frequently begin laying at five months of age, but these are usually too small and although they may lay constantly, are not large

enough, or strong enough, for parent stock. Select the pullet that grows to a good size quickly and lays continuously for a long period.

SELECTION ACCORDING TO FORM.

Many rely on selecting their best laying fowls by merely studying the form, or in other words, they believe that there is a characteristic egg type. Trap nest records seem to indicate that this rule is variable to some extent, at least. One should be able to select by form with fair success, as it has been noticed that hens with crow heads, that is, long, peaked heads, are seldom good layers. The same is true of hens that are unusually long legged. All those that are crooked breasted, or in any way deformed, should be discarded, not for fear that the chicks will inherit the deformity, but because it shows weakness; a bird with a crooked breast cannot present a very good appearance on the stand in the market. It is essential, however, to know by form and type which ones should be kept. Some of the most important factors relating to form, aiding in selection, are embodied in the following: A triangular shape, with deep, broad bodies, showing a large capacity for egg production, well sprung ribs and flat backs that broaden out toward the rump. Some claim that they can readily tell the good producers by a large space between the pelvic bones. Careful examination of a number of hens will show that in some cases, at least, there is a variation in the distance between these bones.

SELECTION OF GOOD FEEDERS.

The appetite of the hen is some indication as to her productive capacity. Those with good appetites will meet one at the door at feeding time and, if at all tame, may hop on to the feed basket. They will scratch the litter about the pen in a vigorous way in search of hidden grains, and may be heard singing away contentedly as they work. They will always be active, never drooping around the pen or staying on the roosts after the others have left, in fact, the first hen about in the morning may usually be considered one of the best producers. The reason for this is simple. If she requires just food enough to supply the wear and tear of the body it will not take her long to secure it, but if she is a good egg manufacturing machine, a large supply of fuel is needed to keep the mechanism running. The fuel furnishing this energy is found in the food consumed.

SELECTION AND AGE.

A question that attracts considerable attention relates to the age of the hens to produce eggs for incubation. Many people disapprove of eggs from pullets, but we believe those secured from pullets that have laid all winter and from yearling hens with good records are the most satisfactory. Extra good producers may be kept for breeding stock until their third or fourth year, or even longer, but usually hens coming two years old make the best breeders. But if hens have extra good records they should be kept as long as they continue to do well. It would be a decided advantage if we could breed hens capable of maintaining a high standard of production for several years. All of the

large farms specializing in egg production would gladly pay an extra price to secure foundation stock that could be used profitably for several years. On many of these farms chicken raising is a great trouble and expense; the cockerels are considered a by-product to be disposed of as soon as possible. Hens bred especially to lay which do well for one year only should be fattened.

MATING.

Having selected the hens that are suitable to produce eggs for hatching, see that they have good, clean, comfortable quarters, with plenty of fresh air, and all the sunshine possible. Mate them with a good, strong male which comes from productive ancestry. The male is half the flock and if his dam and granddams were producers of two hundred eggs per year he should be worth much more as a sire than one whose dam produced but half that number. The question is often asked, how many hens should be mated with one male? This varies with the individual and the breed. The best results are usually obtained by keeping about fifteen of the American class (Plymouth Rocks, Wyandottes, etc.) with one male, while with Mediterraneans (Leghorns, Minorcas, etc.) one may keep as high as twenty-five, while in special instances as high as fifty have been known to give strong fertile eggs from one male. The Asiatics (Brahmas, Cochins and Langshans) are not as active and usually from seven to ten is about the proper number. Having allowed the male to run with the flock for a couple of weeks, it is safe to begin saving eggs for hatching.

EGGS FOR HATCHING.

One should be as careful in selecting eggs for hatching as in selecting parent stock. Choose medium to large eggs, as nearly perfect in shape and color as possible. Uniformly colored eggs look much better than a mixed lot and will usually sell better. Some select the short, round eggs, believing these will produce a large percentage of pullets; but the shape of the eggs has nothing to do with the sex of the chick. Continuous selection of the roundest eggs will gradually produce a strain of hens that will lay round eggs of imperfect shape. Some hens habitually lay eggs flattened on one side, others lay long, pointed ones, while still others lay those with porous, crumbly shells; such hens should be removed from the breeding pens as soon as discovered.

SHIPPING EGGS FOR HATCHING.

In shipping eggs for hatching, great care must be taken to prevent injury in transit. There are several methods of packing eggs; one is to place them in an ordinary shipping crate and fill all the spaces between the eggs and cardboard with sawdust. Another good method is to wind a small bunch of excelsior around each egg and pack so snugly in a basket or box that they cannot move about. Upon arrival, the eggs should be put in a room kept at an even moderate temperature and allowed to remain undisturbed for at least twenty-four hours, when the package may be opened and the eggs placed under the hens or in the incubator. Because of the rough handling to which eggs are subjected

in shipping a rest of twenty-four hours is needed to enable them to assume a normal condition and to permit the germs to swing back in place before incubation begins. If the misplaced germs start to grow, a large percentage of them will die during the period of incubation.

STORING EGGS FOR HATCHING.

In general, eggs cannot be set the day they are laid. Place them in a room where the temperature is fairly constant and at about 60° F. Turn them carefully at least once a day. If the air is very dry, sprinkle the floor with water, or place a few pans of water in the room, otherwise there may be a rapid evaporation of moisture from the egg, leaving a big air cell in the large end of it. One can readily determine the amount of evaporation by marking the air cell while holding the egg in a ray of light passing into a darkened room and then examining it again in the same manner after a couple of days. There should be a very slow increase in the size of the air cell. Eggs intended for incubation should be kept no longer than is absolutely necessary. Two weeks is about as long as it is safe to keep them, although with good care, under proper conditions, they may be kept longer. The fresher the egg, the more likely it is to hatch a good strong chick. Many farmers practice setting the eggs from one day's laying, which is not objectionable providing proper care has been exercised in sorting the flock to secure sufficient eggs of uniform size and color.

When the hens all run together and the finest shaped eggs from the whole flock are chosen, increased egg yields cannot result, as the chances are that some of the hens that have been laying well all the fall and winter are now ready to sit. Those that have not laid for months are the most likely to do so for a few weeks in the spring, and often produce fine large eggs, due, perhaps, to their long winter's rest. The use of eggs from such hens can only result in deterioration of the flock.

INCUBATION.

NATURAL OR ARTIFICIAL INCUBATION.

After selecting the eggs they must either be entrusted to hens or an incubator; this must be decided according to circumstances. If it is not the intention to keep many hens or raise early chicks, by using one of the heavier breeds of fowls, one can get along very well without an incubator. Some poultry raisers claim they can care for a machine with less trouble and expense than the necessary hens, no matter what breed they may keep. One thing is certain, however, the machine will bring off chicks at any season of the year that may be desired, while one must wait until the hens get ready to sit. If Leghorns or other non-sitting breeds are kept, an incubator is an almost indispensable part of the equipment. Some individuals of non-sitting breeds may make good mothers, but so many of them cease sitting after the first few days that they are very unsatisfactory, as a rule. If individuals of other

breeds as Cochins, Wyandottes, etc., seem inclined to sit and would make good mothers, they may be used, providing chickens are wanted at that time. It is claimed that the hen's time is too valuable to waste in sitting, but if she is properly cared for while broody, it will serve as a resting period, and she will probably lay about as many eggs in the year as she would if confined to the coop for a few days to break up the desire to incubate. After a hen has hatched and reared a brood of chicks she will usually begin laying again and apparently seem to try to make up for lost time. It is a mistake to kill a hen just because she raised a brood of nice chicks. She probably will be one of the best layers the next winter. Some hens, however, seem to be chronic sitters; these are of little value for anything but hatching chicks and might as well be killed if they are not wanted for that purpose. Such hens develop but few eggs at a time and can never make a good year's record.

BREEDS ADAPTED TO INCUBATION.

The question of the relative merits of the different breeds as sitters often arises. There is much difference of opinion on this subject and also a great difference in the individual hens themselves. In general, however, the Cochins and Wyandottes make very good sitters. Some may prefer Plymouth Rocks, Rhode Island Reds, etc., but we believe that no other breeds are as nicely feathered for incubation purposes as the Wyandottes and Cochins. It is generally conceded that Leghorns, Minorcas and others of the special egg producing breeds do not make good mother hens. Some of these make good sitters, but far too many will prove worthless for the purpose.

THE NEST.

In the first place one should select a good location for the sitting hen. When they are located where others can lay in with them, trouble is sure to occur, as they generally quarrel over the nest, thus breaking and soiling the eggs. Therefore, it is essential to secure a place where there cannot be any possibility of disturbance. The nest may be made of soft hay sprinkled with sulphur and powdered tobacco stems, or some other good insect powder to prevent the ravages of lice. After nightfall select those hens that have been sitting steadily for a few days and remove them to the prepared nests. If they do not settle down contentedly at first do not entrust them with eggs, until safe to do so. Some hens prove too cranky to be profitable even though they do not cease incubation entirely, or spoil the nest of eggs; they should be taken off the nest and fed once or twice to test their dispositions. If they go back on the nest of their own accord it is safe to entrust them with eggs. If they do not go back at the end of half an hour, catch and place them gently on the nest. Some hens learn to go back quickly and take their own nest, while others are very slow.

A very serviceable nest is made by cutting a door in the side of a barrel and hinging it fast with light hinges or straps. Place old newspapers on the bottom and then make a nice firm nest of soft hay. Be sure and make the nest so large that the eggs will not pile up on each other under the hen, but not large enough to allow them to roll away from her body. The top of the barrel can then be covered with boards,

old sacks or anything of the kind convenient. The top hoop may be removed and a sack fastened down the same as in shipping potatoes to market in barrels. Small holes can be bored in the side to admit plenty of air. Good nests may be made from boxes about 15″x15″x15″. Remove one side with the exception of a 6″ piece at one edge which serves as the bottom of the nest on the front side and holds the nest material in place. Hinge the part removed to one edge, thus making a door that can be quickly opened or closed. Nests of this style may be made in sections of five or six and placed one above the other, when one has to be economical of space. A small room may be lined around next to the wall with such nests and the blank space in the center left for feed and water dishes.

FOOD AND MANAGEMENT OF SITTING HENS.

If the hen is well disposed and can be left to come off the nest at will, little or no trouble is involved. If for any reason the hen has to be confined to the nest she should be taken off regularly once a day and allowed to eat and drink. Good sound corn is about the best food for sitting hens, although they may be fed such grains as wheat, oats, barley, or buckwheat. Rye is not recommended, as the hens do not like it and it does not prove to be a very healthful food for them. Grit, in the form of coarse sand or broken stone, should be kept convenient. Water must also be supplied. If the weather is hot, keep water inside the nest so that the hen can drink whenever she desires. Otherwise she becomes very thirsty and drinks too much at once, often resulting in bowel trouble and diarrhoea. Some take the hens off the nest in the morning and allow them a little run in the wet grass. In that way the hen's feathers become moistened slightly, thus adding a little moisture to the eggs each day. If the nest is in an extremely dry place moisture should be added in some way. There are several ways of keeping the eggs sufficiently moist. The practice of allowing the hens to run in the wet grass each morning is one of the best. Another is to place damp earth and sods under the eggs. A third method, and one probably most largely used, is to sprinkle or dip the eggs in water heated to 103° F. This is done at least twice, once about the 14th and again the 18th day of the hatch. If the eggs are on the ground or in a damp place no moisture should be added. When removing the hens from the nest, handle them carefully. Many good hens are spoiled by careless or rough handling. If the hen has to be caught in order to put her back on the nest do not place her directly on the eggs but on the edge of the nest, thus allowing her to cover them in her own cautious way.

PRECAUTIONS AGAINST LICE AND MITES.

Sitting hens must be kept free from lice and mites. In order to rid them of these pests take each one gently by the legs and with the head hanging downward, dust the feathers well with some good insect powder (see page 120) and replace on the nest. This should be repeated about the 10th and 18th days of the hatch. Attention to lice at this period may save many chicks later in the season. A hen cannot be a satisfactory sitter if she is infested with lice. Very often those that are well fitted by nature for good mothers are driven from the nest by

insect pests. The lice running around over the body and gnawing at the skin and feathers cause intense itching and in trying to get away from these pests the hen forgets all about her desire to sit and deserts the nest. If strongly inclined to sit she may desert one nest and move to another, trying to escape her enemies. If a hen shows any sign of uneasiness be careful to inspect her body for lice and also the cracks and crevices about the nest for mites. If either is found, thoroughly dust her once more, sponge off the eggs with a damp cloth and move to a clean place. Burn everything about the nest and either thoroughly disinfect or burn it. Wage constant warfare against lice and mites during the period of incubation and the result will be a clean lot of chicks. It has been said that three lice will break up a sitting hen or kill a brood of chicks. This probably is not always true, but it is certain that a hen that starts to incubate with three lice on her body will probably have enough by the end of the hatch, unless properly cared for to infest all the chicks and render the whole brood either very unsatisfactory, or worthless. An ounce of lice powder at the beginning of the hatch is worth a good many pounds after the chicks are a few weeks old.

ARTIFICIAL INCUBATION.

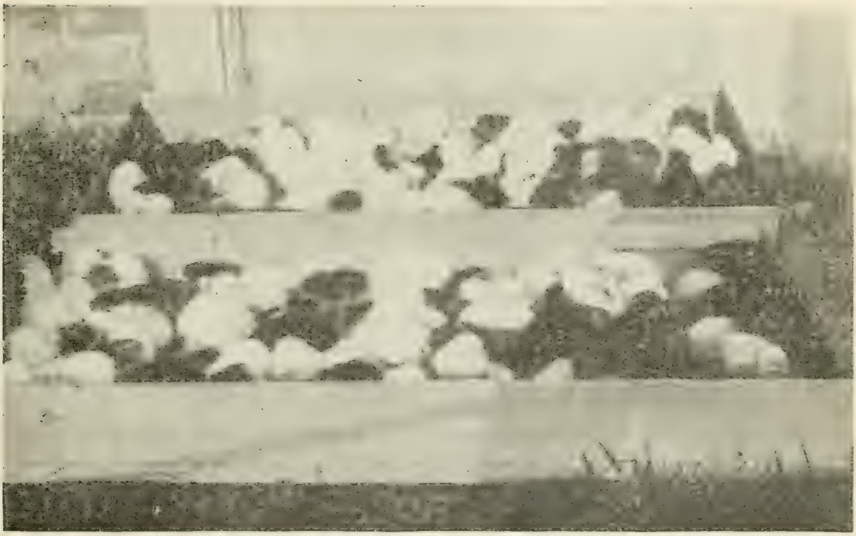
The selection of an incubator is one of the most difficult problems confronting the beginner. There is no make of machine that is better in every respect than all others. Some people seem to do better with one make of machine, while the success of others is secured through the use of another sort. There are a lot of good machines on the market and we should try to select one of these, even if the price is a little higher. It costs more to build a good machine than it does to fasten a lamp onto a single walled box, but the good machine will soon save the extra cost by hatching more of the fertile germs and saving in time and temper. A well-constructed machine is also less likely to take fire. Any of the better machines can be safely operated by anyone who is careful enough to be allowed to clean and care properly for kerosene lamps.

Having decided to buy a machine, write to the companies that advertise in your papers. Do not depend too much on testimonials as successful experiences only are related. Testimonials are most valuable when they come from some one in reputable standing in the poultry business. If some friend or neighbor already has an incubator go and see it and get all the information possible relating thereto. He perhaps has seen or used other machines and can, therefore, advise concerning them. Most of the companies have agencies in the larger towns, and one can see the machines there. Buying from a local firm saves freight, and may prove more satisfactory in other ways.

The best place to operate an incubator is often a perplexing question on the farm. A great many find the cellar to be the most suitable place, and it will answer if it will keep vegetables and apples without molding. The dining room or kitchen is sometimes used, but the variation in temperature is often too great to give satisfactory results. Although a properly constructed machine will do good work with a little care, where the range of temperature amounts to more than 20° F., a less varying temperature will be found more satisfactory.

Having decided where to run the machine, unpack and set it up carefully, according to the accompanying directions. Before starting see that the machine is level. If the floor is uneven or sloping, block up under the legs with pieces of shingle or blocks of wood. Choose a place in the room that is free from draughts or sudden gusts of wind which may blow the lamp out, or start it smoking. Direct sunlight should not fall on the machine for any length of time, yet the room should be reasonably well lighted and ventilated. Proper ventilation is necessary as the unhatched chick requires air in order to develop properly.

Use nothing but the best grade of lamp-wicks and oil. Be sure that the incubator lamp burns with a flame such as is desired in an ordinary house lamp. If the lamp smokes a little at first do not be alarmed, but allow it to warm up and dry out. When starting, screw the thermostat nut down until the rod almost, but not quite, lifts the damper. In this



A SUCCESSFUL HATCH AT M. A. C.

way the risk of breaking the thermometer which usually registers but 110° F. is avoided. On returning to look at the machine one should find the damper raised, if so and the temperature is not up to 100° let it down and so on until the machine registers 103° with an ordinary flame. The thermometer is a very important part of a machine and should be taken to a druggist or some one having correct thermometers and tested for accuracy. Although nearly all firms endeavor to sell accurate thermometers this precaution will sometimes repay the trouble involved. For experimental purposes record the correction at 100°, 103°, 106° F.

Then, with a corrected thermometer and the machine regulated to the proper temperature, put the eggs in, being careful that they are moderately warm from having stood in a warm room for an hour at least. Careful work is now needed to see that the machine varies as little as possible from the proper temperature. A slight variation, however, is not to be feared unless it is of long duration. Do not throw

away a lot of eggs unless certain that they have been spoiled. Test about the 7th and again the 12th day to remove the infertile eggs and the dead germs. With a little practice one will soon learn to test rapidly. Cool the eggs once a day after the second day and until the 18th. Turn twice a day during the same period. It is a matter of considerable interest to know that the hen turns the eggs frequently and moves them about in the nest. After the 18th day do not open the incubator until the hatch is over, then remove the shells and eggs that have not hatched.

BROODING.

FOOD FOR CHICKS.

Neither naturally nor artificially incubated chicks should be fed until forty-eight hours old, when they may be given a mixture of two parts rolled oats and one part hard boiled eggs, chopped fine, including the shells. Or they may be fed two parts dry or stale bread and one part hard boiled egg. If the bread is not perfectly sweet it may be toasted, in fact, it is a good plan to toast the bread anyway. A little burnt or scorched bread is often found beneficial in cases of bowel trouble. Another ration could be made of one part granulated milk, two parts bran and one part corn meal. If sweet skim milk is obtainable they may be fed the bran and meal dry and given milk to drink. A great many different mixtures are used in starting chicks, but hard boiled eggs, mixed with some meal or ground food is usually considered the best ration for the first few meals.

Some do not use the dry mash just described, but prefer a scratch food instead. The scratch food, for the first few days, may consist of the following mixture, viz.: one part millet seed, one part kaffir corn, two parts finely cracked wheat, two parts finely cracked corn, and two parts pin head oats. A number of somewhat similar foods are on the market and generally give satisfaction. The scratch food is fed in a thin litter at first, which is gradually increased as the chicks are enabled to secure the food, until it is about four or five inches deep.

NATURAL BROODING.

If the chicks are to be raised with hens a supply of small coops will be needed. The common inverted V-shaped coop is quite satisfactory in warm weather, or even in cold weather, if it is placed in a sheltered location, or in a shed. The sides forming the roof of this coop should be two feet in length at the peak and three feet long from the peak to the ground on the slope and the angle where the two meet should be about 75°. The back should be boarded up tight. The front should be boarded down about one-third of the way from the top and the remainder slatted. This is probably the most common coop in use in this country.

Another very good coop for hens with chicks in cool weather, con-

sists of a house three feet six inches by four feet two inches. It should be three feet high in front and two feet six inches in the rear. Hinge the front side on as a door which should have a light in it; then board the remainder tight and cover with building paper. The hen may be confined in a crate within and the floor covered with fine litter. This will prevent the hen covering the chicks with chaff when scratching. As soon as the chicks are a week old the crate can be removed as the chicks will then be active enough to keep out of the way.

Early chicks can often be kept in an unused stable or building that is well lighted. A fairly constant temperature aids growth and thus gives more satisfactory results. Later in the season, after the cold winds and rains are over, place the hen and chicks in a small coop out of doors. The coops may be used without floors unless rats are troublesome, in which case they will need perfectly solid floors. The coop should be moved every day or two to prevent killing the grass under it, and secure clean premises.

If hawks and crows are troublesome, a run can be made in front of each coop, using inch mesh wire netting when the danger is great. If the danger of loss from this source is not serious use a two-inch mesh netting to allow the chicks to go through and forage outside. The runs should be moved to fresh ground every few days.

A barrel may be converted into coop for housing a hen and her chicks. Dig a hole in the ground large enough to admit one-third of the barrel. Then place the barrel on its side in the hole and put the earth in it, even with or slightly above that outside. The head should be left intact in one end. Remove the other end and drive stakes in the ground before the opening two inches apart, thus confining the hen and allowing the chicks to pass through. Packing boxes may be used in various ways if covered with building paper, but in general it will be found more satisfactory to build good, substantial coops which can be used for several years.

ARTIFICIAL BROODING.

If chicks are to be reared artificially the brooder should be heated for three or four days before it is to be used. In this way it is dried thoroughly and put in good working order before the chicks are entrusted to it. Cover the floor of the brooder with fine sand and then with clean chaff or finely chopped straw. Clean, sweet hay chaff is excellent for this purpose as the little chicks usually find a great many grass and weed seeds which make excellent food for the first few days.

Care should be exercised not to feed the chicks too heavily at first. This is especially true of brooder chicks, which seem to be lonesome, and will come to meet you every time you go near them. Feel their crops occasionally and if they are not empty withhold food until they are nearly so. Ordinarily young chicks should be fed five times a day, and then only what they will clean up quickly. If any mash food is left at the end of fifteen minutes it should be removed. If too much scratch food is fed at one time be careful to withhold the next feed until the chicks are real hungry. Over feeding or any thing tending to derange the digestive tract may result in serious losses. Keep a constant supply of clean, fresh water and plenty of grit in the form of sharp sand, or broken rock. Charcoal also proves very beneficial when added

to the diet. Both grit and charcoal may be obtained from dealers in poultry supplies; there are at least three sizes of each on the market; in ordering, secure the small size for little chicks. Charcoal may be obtained by sifting wood ashes. If brush or rubbish can be burned so that the chicks have access to the bed of ashes they will soon learn to hunt for charcoal there, and it also serves as an excellent dust bath for them. The mixture of wood ashes and soil seems to suit their wants exactly.

After the chicks are a few days old the hard boiled eggs may gradually be omitted, and a scratch food composed of cracked corn, wheat and pin head oats, substituted. On the average range there is a deficiency of meat and this should be supplied in some form at least until the chicks are a month old, when they are better able to secure insects. The meat then must be fed according to the amount available on the range. At this stage the following mixture may be used, viz.: two parts hulled or pin head oats, two parts wheat, one part cracked corn, and one part beef scrap, or cracked corn and wheat, morning and night, with a dry mash feed at noon, composed of four parts bran, two parts corn meal and two parts beef scrap or granulated milk. In fact there are many combinations of food that may be fed at this time. The main thing is to feed food that will supply bone and muscle forming material to build up good, strong, healthy birds. If insects are abundant no meat need be fed, but if green food is lacking it should be supplied.

After the chicks are a month old it is well to allow them to run to self-feed hoppers and help themselves, or to feed them three times a day on equal parts of pin head oats, wheat and cracked corn morning and night. The feed hopper contains a mash food composed of six parts bran, three parts middlings, three parts corn meal, and beef scrap, according to the amount of insects on the range. Beef scrap would seldom be more than three parts and not often more than one part in the above mixture.

The feed hopper may be made at home or can be bought for a small price from most dealers in poultry supplies. It consists of an arrangement which allows the feed to come down no faster than it is eaten out from below. For the end pieces select a board six feet long and eight inches wide, cut it slantingly across through the center so that the slope will be about one foot long, thus furnishing a frame for a sloping top upon which chickens cannot roost. Board up the back or long side of the end pieces and put the bottom in about three inches above the ground. Put a board four inches wide across the front, thus forming a trough with the bottom. Then cut a board to fit into the hopper at an angle of about 45°, being highest in front to deliver the feed in the trough at a point three inches from the back and four inches from the bottom board; enclose the front from this board up and hinge the cover on. If it is desired to allow the chicks to eat mash feed only at certain times, a board can be hinged over the opening of the trough. The dimensions of this self-feeder must be determined by the number of fowls to be fed from it.

A very good self-feeder used at the Maine Experiment Station is described in Bulletin No. 90, Bureau of Animal Industry, Washington, D. C. "The troughs are from six to ten feet long, with the sides five inches high. The lath slats are two inches apart and the troughs are sixteen inches from floor to roof. The roofs project about two inches at the

sides and effectually keep out rain except when high winds prevail. The roof is very easily removed by lifting one end and sliding it endwise on the opposite gable end on which it rests. The trough can then be filled and the roof drawn back into place without lifting it."

During the whole summer, constant watch must be kept to see that the growing pullets have plenty of shade and water. Neglect these two essentials and they will not fill the egg basket the next winter. If trees are not already in the yards plant them the following spring. Use fruit trees to get both shade for protection and fruit for chicken food and market. Plum and apple trees are excellent for this purpose. Peach trees make a more rapid growth and hence furnish shade quicker. If trees are not to be had, a very good shelter can be made by fastening an old door, or something of the kind, on legs about six inches long on one end and one foot on the other. Chickens do not like to take refuge in the house during the day, and something suitable should be provided to protect them from the sun's rays.

SOME DISEASES OF CHICKS.

GAPES.

This is probably one of the most serious causes of loss among chicks. It is caused by a small worm that accumulates in the windpipe until the chicks suffocate. The affected chicks constantly try to dislodge the worms by gaping and shaking the head. If the chick is quite large it can usually manage to throw off the disease. If, however, the disease attacks small chicks, they usually succumb to it, or become stunted.

There are several ways of treating gapes, but in all cases the first thing to do is to separate the unaffected ones from the rest and move them to fresh ground as the disease spreads rapidly if this precaution is not taken. The common earth worm is said to be a means of spreading the disease as it is very frequently found to be a host for gape worms. If there is danger of gapes, use solid floors in all the coops and keep the chicks confined when there are many earth worms on the surface.

Several patent devices for the treatment of gapes are on the market; some of them are very good for the purpose while others are of doubtful value. If the chicks are considered worth the trouble, the quill and turpentine treatment is probably about the best, and is used as follows: Dip a quill in turpentine and then insert it gently into the wind pipe. The quill must of course enter the wind pipe in order to effect any cure. The operator will see the opening of the wind pipe at the base of the throat. Numerous complaints are made that the treatment does no good because people frequently insert the quill into the gullet instead of the wind pipe.

A looped horse hair may also be used for dislodging the gape worm. Insert it into the wind pipe; give it three or four turns and then remove, after which the chick will cough up any worms that have been dislodged.

Gape worms may be killed by placing the chicks in a closed barrel or some other convenient receptacle and forced to inhale strong tobacco fumes, or those of a similar nature. This method is not recommended very highly, as it is extremely dangerous. The treatment will of course kill the chicks if continued too long and thus an inexperienced operator finds it difficult to use.

In combatting this disease, as well as all others, healthy, growing chicks are much more likely to overcome the trouble than weak, neglected ones.

DIARRHOEA.

Another common disease of chicks is diarrhoea; they are affected with both the white and black forms of this trouble. A lack of heat and an excess of the same are prolific causes of diarrhoea in small chicks, but sometimes improper feeding is the cause. Too much heating food, as corn meal, sloppy, or decaying food, or in fact anything that may cause a derangement of the digestive tract is likely to produce this trouble. Chicks properly hatched from strong, vigorous stock are much more likely to resist the disease, as their organs of digestion are stronger.

LEG WEAKNESS AND CROOKED BREASTS.

This trouble is especially prevalent when chicks are brooded indoors during the cold months. It is often caused by improper feeding. The chicks when thus affected are not getting a proper amount of bone and muscle-forming material and the ration is particularly lacking in ash. This must be supplied in some form to make it palatable. The best way of doing this, so far as known to the writer, is to add fine ground bone either raw or cooked, animal meal, and milk in some form. Milk has been found especially good in supplying this lack of ash in poultry supplies. Feed a mixture of grains as recommended heretofore, and add fine ground bone, animal meal, milk, vegetables, clover or alfalfa. and furnish a plentiful supply of good clean sand or grit. In some cases the ration may have been right and the chicks suffered from a lack of exercise. Without sufficient exercise there will not be a normal development of the digestive organs, bones and muscle. A good, clean range out-of-doors will usually correct this trouble, although if they have started to get crooked breast bones they never can be cured. Crooked breasts are occasionally caused by chicks roosting too early in life, but the trouble is generally caused by improper handling in the early development. Brooder chicks at two weeks of age are sometimes crooked breasted, the result of improper feeding and lack of exercise. Correct the ration as suggested for leg weakness. The digestive organs in birds thus affected are found to be out of proportion to their body weight. This development is probably due to the chick eating too much food, lacking in ask, in the attempt to secure the mineral elements which should be fed in a more concentrated form.

If the chicks are not taking enough exercise and a range is impossible on account of severe weather or other conditions, increase the amount of litter and force the youngsters to spend more time scratching for their food, but do not make the mistake of requiring them to work too much at first, as a chick with muscles and bones already weak, must be built

up gradually. Frequently the attendant discovers that a brood of indoor chicks are getting weak. He is, perhaps, feeding a good supply of green bone and other bone-forming material. He desires, therefore, to make them take more exercise. With this in view he doubles the amount of litter and decreases the food, with the result that the chick in the attempt to satisfy its hunger, works too hard for its bodily strength and fails entirely. Frequently leg weakness is accompanied by constipation, which is relieved by the addition of green food and an increased amount of exercise.

LICE AND MITES.

Other foes of little chicks are external parasites, lice and mites. We frequently find lice even among winter brooder chicks. Lice on the head are most troublesome. They fasten themselves to the back of the chick's head, near the base of the brain and gradually kill the chick. It is a pitiful sight to see the little chick scratching the back of its head trying to dislodge this pest. Good results are usually obtained by greasing the head of each chick with 5 per cent carbolated vaseline. Kerosene and lard, equal parts, prove equally effective. The chicks can be rapidly treated and should be attended to as soon as there is any suspicion of head lice. The louse may be seen readily by means of a small magnifying glass. It can also be detected with the naked eye if one is very careful to examine the right place, although one must look carefully to see it.

To kill mites, clean all coops and brooders perfectly, then apply thoroughly, either white wash, kerosene oil, or some of the prepared insecticides. Be sure to fill all the cracks and crevices as these are the places where mites will be found hiding during the day. Burn all the litter and add new. A spray pump may be used for applying the insecticide, as it drives the liquid into the cracks and crevices better than can be done with a brush. Whitewash can be applied with a pump and then smoothed over with a brush, doing rapid and effective work. Mites differ from body lice in that they suck the blood from the fowls' bodies, while lice have biting mouthparts and live on the skin and feathers, causing intense itching and annoyance. Mites live on the fowl's body at night only, hiding in cracks and crevices during the day. They appear red when gorged with blood, or white when there is little blood in their bodies.

To kill the lice we must treat the hen's or chick's body, as the lice live there practically all the time. There are several kinds of these lice, but they all yield to the same treatment, namely, a good dusting. The dust fills up the breathing pores in their bodies, and thus suffocates them. A good insect powder may be made from equal parts of fine ground tobacco and powdered sulphur. Snuff is also used. There are a number of insect powders on the market and most of them prove very satisfactory. Pyrethrum or Persian insect powder can be purchased at any drug store and if fresh is effective. The essential thing is a finely pulverized substance that will go through the feathers.

Having carefully dusted the chicks (and hens, if the chicks are running with them) clean the houses and remove to clean ground. A good dust bath should be arranged so that the hens and chicks may help keep

themselves clean. An excellent dust bath is made by drawing a load of "chip-dirt" and dumping it in the yard where the little fellows may have ready access to it. For winter use a box partly filled with fine sand, road-dust, land plaster or coal or wood ashes answers very well. A mixture of sand and land plaster seems to please them more than either one alone. Some use wood ashes alone, but a mixture of wood ashes and road dust, or fine sand, makes a heavier bath and therefore more effective in cleaning the lice out of the feathers.

If the fowls or chicks are badly infested, do not depend entirely on a dust bath to rid them of the parasites. Examine them carefully in the day time and if small parasites are found on their bodies, give them a thorough dusting, or if small red or white mites are found about the cracks and crevices of the house and perches, thoroughly treat as described above. Simply because a house has not been used for a long time is no assurance that it is clean. It may be full of vermin even after years of idleness. Keep a constant lookout for vermin, and treat thoroughly when found.

HANDLING YOUNG STOCK.

As soon as the chicks weigh a pound or a pound and a half, the mother should be taken away if she has not already deserted her brood and commenced laying. This is a critical time in the young chick's life, as the youngsters are likely to run from coop to coop just at dusk searching for the warmth of the mother hen. Some prefer to move them to larger coops than those in which they have been raised, thus far, but usually it will be found more satisfactory to leave them in the "chick coops" until they are well weaned from the mother hens. Be careful to keep them from crowding together in a few coops. This crowding is often the cause of weak and almost worthless chickens. If the chicks have not been examined after they are all settled for the night, go from coop to coop and make a careful examination to be sure that there are not too many in one house. If a house is found with a large number in it, run your hand in among them and note the high temperature. You will then understand why this crowding is so dangerous. Also notice the tendency for the chicks to crowd together in the coops that are fed first in the morning. To prevent this, change the order of feeding so they cannot tell which will be the first to be fed at the beginning of each day.

Be careful also that they do not sleep on the ground as this will cause them to sweat. The ground is moist and cool, while their bodies are warm, this causes the feathers to become saturated with moisture. Then when they go out in the early morning they are readily chilled, thus making them unhealthy. The moist, damp atmosphere is also unhealthy for them to breathe during the night.

Perhaps by this time the young males are beginning to annoy the pullets. At the first sign of this approach to maturity the pullets should be removed to other quarters. If a portable house with a good

roof is accessible, draw it out into a nearby meadow or corn field. The sides of the house may be enclosed with wire which should be covered with cloth or burlap on the north and east. This will prevent a direct draught on the chicks. The general trouble with summer houses is from too little rather than too much air, yet a direct draught should be avoided.

The mash feed at this time should be similar to that used earlier. A mash composed of two parts corn meal, one part bran, and one part middlings has been found very satisfactory. This feed may be placed in a self-feed hopper and the pullets allowed to help themselves. They will be able to find plenty of meat in the form of insects on most ranges. A flock of growing pullets will do more to rid a meadow of harmful insects than a lot of such pests as crows, and one will find that even in the corn field they do no harm if properly fed. With a large run they do but very little scratching, as they seem to prefer to run down an insect rather than dig one out of the ground. They will, of course, appropriate a small place for a dust bath unless you furnish them with one.

The house should be constructed so that it can be locked. Leave a place, however, where the pullets may go in and out at will. If they are allowed to do this you will find that about three o'clock in the morning they will come stealing out and scatter over the meadow. The grasshoppers are now sluggish with the cold dew and are readily picked up and devoured. Perhaps the good that the pullets do to the crops has been emphasized more than the good they derive from the open range, but a single trial should convince the most sceptical that the healthiest kind of fowls can be raised in this way.

In case the owner of the fowls lives in a village, so plan your chicken house, yards and garden that the hens can be readily changed from one place to another. As soon as the early vegetables have been removed from one part of the garden, seed the ground to rye. When the rye has made a good start, turn the pullets in and let them dig and scratch all they will. Some may say that this is too much trouble, but those who have tried it are satisfied with the results. One cannot expect to raise strong, healthy chicks on ground that has been poisoned for years by preceding generations of fowls. Plow up the old yard and use it for a garden for a year or two. If it is not too rich it will prove an excellent garden and the old one will be greatly benefitted by a year's rest and fertilization by the droppings from the fowls.

Many people have failed in poultry raising simply because when they increased the number kept they did not increase the size of their houses, yards and runs. For instance a farmer or villager is doing well with thirty hens. He determines to increase the number to one hundred. The next spring he hatches about three times as many as formerly and raises them on the same range. The range probably could be kept sanitary with fifty chicks, but when increased to one hundred and fifty they do not grow strong and vigorous. Before increasing the size of the flock consider the possibilities for greater facilities to accommodate and handle them properly. Provide ample house room to accommodate the increased flock for winter. Each hen should have about five square feet of floor space. Measure the house and see how many hens

should be kept in it and then do not attempt to keep more than the space will allow.

The ability to grow strong, vigorous pullets during the summer is considered the most important factor in winter egg production. Some may not agree with this, and it is surprising the large amount of literature that has been written about winter housing and feeding, all of which is very essential, while but little has been written about the summer and early fall management of pullets. Good houses are costly and from that standpoint should be given much attention, but the great advantage of this system of summer management is that it costs almost nothing—a little extra time and trouble to feed.

If a convenient house for summer is not already available, one may be constructed very cheaply. A summer house to accommodate thirty pullets should be 8x10 feet, with a 6-foot front elevation and 4 feet in the rear. If care is taken to clean this house and keep it so, one may handle as many as forty pullets in it. If the desire is to keep more than forty pullets in a house it should be constructed large enough to give each one at least two square feet. Cheap lumber and building paper will make a serviceable roof; the frame may be cut in the wood lot if necessary, otherwise use 2x4 inch scantling. Cover the sides with wire netting and then with a few cents for cloth or burlap cover the sides and a good summer house is complete. The south side should be left so that the cloth or burlap can be rolled up except when storms come from that direction. Such a house should be placed on two good oak runners with clevises attached so that it can be drawn to any part of the farm. A movable floor should be placed in the house and covered with straw or chaff. This litter should be removed frequently in order to keep the house clean and sanitary. When the pullets are four months old, roosts may be placed inside and they will soon learn to use them.

If birds are to be shown at the fall or winter fairs one will find the pullets that have been raised out in the open where they ranged at will are much stronger, with brighter and more lustrous feathers than those chicks raised in confinement. One of these free range pullets when confined to coops will need a little more training, but will endure a long journey and the strain of the show room much better than the one that has been raised in close confinement on soil that has been poisoned by years of accumulated droppings.

There may be some disadvantages in the free range system for pullets, such as the requirement of extra time and trouble which have already been discussed. There remains, however, the question of hawks, crows, skunks and other vermin, which may be troublesome in some localities. If care is exercised to shut the doors at night and have the opening two feet from the ground there should be no more trouble with any night prowling animals than is likely to occur in a small yard close to the house. Hawks probably are the most troublesome in the day time and should be shot whenever they visit the chicken yard. Crows seldom trouble chickens large enough to put out on the range. Where hawks are quite troublesome a corn field makes an excellent place to keep the pullets as the chicks will usually hide away so that the hawks cannot see them. Those who have tried the free range say that they

find the hawks no more troublesome out in the field than they did near the house.

Illustration number three represents twenty-six White Leghorn pullets reared according to methods outlined in this publication in the last two chapters treating on the Handling of Young Stock and Food, Care and Management of Pullets during the Fall and Winter. Twelve

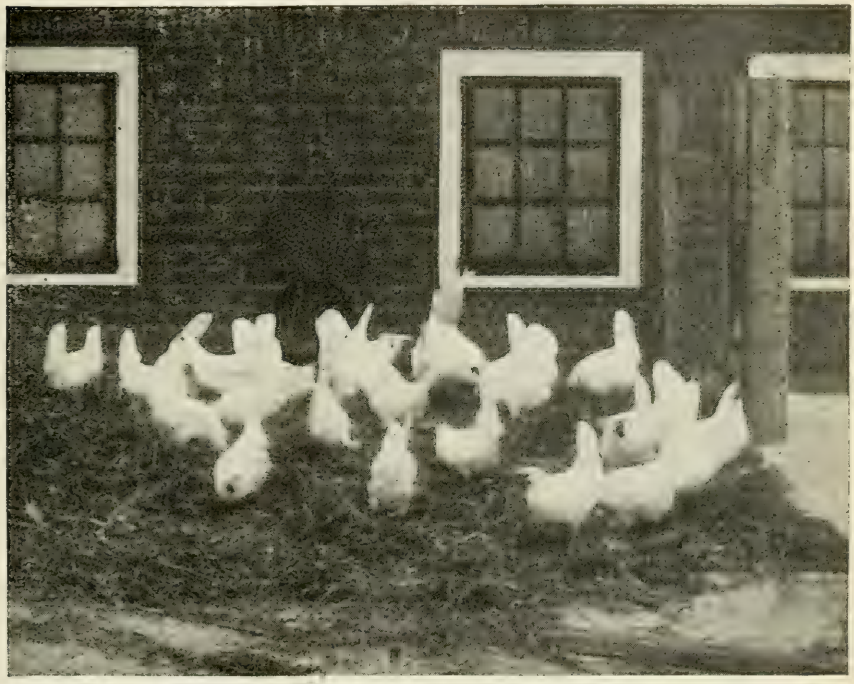


Illustration 3.

of these pullets were hatched early in May, 1906, and the remaining fourteen during the early part of the following month. On November 30, 1906, the average weight of this pen of pullets was three and one-half pounds. The first egg produced by this pen was laid October 23d, and during the thirty days of November a total of 391 eggs were produced by the pen.

FOOD, CARE AND MANAGEMENT OF PULLETS DURING THE FALL AND WINTER.

When the cold nights begin to come, about November 1st, it is time to bring the pullets into winter quarters. They should then begin to show signs of approaching maturity. Before bringing them in, clean the house they are to occupy, whitewash it thoroughly and disinfect the perches, nest boxes, etc. Be sure that the disinfectant enters every crack and crevice. Then cover the floor with about four inches of fine gravel or sand. Cover this with six inches of dry, clean, long straw, as the pullets will break it up quickly enough. Where leaves are plentiful they may be used and make very satisfactory litter, although they do not last as long as straw.

When the house is ready remove the pullets to it carefully. Do not carry them by one leg only or otherwise misuse them. Any rough handling at this time will mean a subsequent loss in the egg basket. Of course a change always produces timidity, but by exercising great care they will soon become accustomed to their new quarters. When about to enter the house a slight noise announcing one's approach before opening the doors will prevent fright and injury from a sudden rush or flight against obstacles in the pen. Chickens soon get to know the call of a low, soft whistle announcing to them the coming of the feed basket. At this stage the reproductive organs are developing rapidly and any abuse or frightening may cause the loss of some of the finest in the flock.

We have entered poultry houses in the winter where the windows have been closed for days at a time. The hens are found standing around with their feathers ruffled and looking as if they were nearly frozen to death. In accustoming pullets to their new quarters, see that they always have plenty of fresh air without a draught. One of the best systems of ventilation is to have a window hinged on one side and cloth on the other so that either one can be swung in at will. Those having sliding windows can arrange to slide one in from either side. Both should usually be left open a little while during the day except in extremely cold weather. Hens enjoy sunshine and fresh air but it should come through the window and not through cracks and crevices. No one should expect hens to lay well in a house that is not constructed with tight walls. The sides of many hen houses are made of unmatched lumber, which has shrunk, leaving cracks through which wind, rain and snow blow, perhaps directly on the fowls. No one should expect hens to do well in such a place. A few dollars spent on building paper and a few feet of battens will work a great change for the better. Simply spread the building paper smoothly over the sides of the house and then place battens on every eighteen inches. A good coat of paint will improve the appearance, and make it more lasting.

Next let us consider the feed that the pullets should have when they come in off the range. While on the range they doubtless found an abundance of green food and meat in the form of grass and insects.

We must supply these two foods when the pullets are confined to the laying houses. If we can secure skim milk at a reasonable price, or have it on the farm it will be found to be an excellent food. Very often one can buy green bone and scraps or waste meat from the markets at a reasonable price. Any of these may be utilized as well as scraps from the table, as long as they are fresh. No one should be guilty of feeding partially decayed meat in any form. We cannot expect people to pay good prices for eggs if our fowls eat unclean food. In some instances the hens are fed the meat from any animal that dies; this practice should not be allowed. Numerous complaints are made annually because even fresh eggs are off in flavor. When the source of the trouble is traced out we invariably find the hens have been fed unclean food, such as hotel swill, horse meat, or other carrion. If milk or meat scraps cannot be secured locally it is better to buy commercial beef-scrap or granulated milk. These will keep indefinitely when properly stored.

The green food may be supplied in the form of cut alfalfa or clover hay. The hens will eat it either dry or steamed. Mangolds or beets and cabbage also make excellent food and should be fed raw. Beets should be sliced lengthways until the hens learn to eat them, when they may be thrown in whole. The mangel-wurtzel is the best variety for chicken feed. The cabbage should be hung up on a string where the hens can get exercise working at it. Onions, turnips, potatoes and several other vegetables may be fed. These, however, should be cooked until soft and then mixed with about an equal bulk of bran; feed while still quite warm. We prefer to feed such a feed at noon. Be careful not to feed too much, as the hens are very fond of soft, moist mash, and will engorge themselves with it if given a chance. Be sure that each hen can get her share and do not feed more than they will eat up clean in fifteen minutes. Also be careful to have the vegetables dry enough so that when the bran is added it will make a crumbly, moist mixture.

Always be careful to feed clean food of all kinds, and shun all bad smelling disinfectants. The egg shell is porous and will, therefore, allow the egg to absorb bad odors. Store the eggs in a clean place and market them at least once a week; by following this method one should soon be able to get a reputation for furnishing eggs that are good and genuinely fresh.

When the pullets are brought in from the range they may not be completely feathered. If not, an occasional feed of sweet corn will be a great treat for them and will help them produce a new coat of feathers. Sunflower seeds contain oil and make an excellent addition to the ration, helping to produce new feathers quickly. Oil meal or oil cake may also be added to the mash feed. We like to use 100 pounds bran, 75 pounds middlings, 25 pounds oil meal, 100 pounds corn meal and 100 pounds beef-scrap. Canada peas also make an excellent addition to the ration during the moulting period. The fowls soon learn to eat them and they will help keep the birds vigorous during the strain of the moulting period.

There is as much in care and management as in the food. Keep the hens busy all day and then give them enough to fill the crops at night. In this way one can have healthy fowls and avoid many bad habits. If a hopper is used to feed mash, supply a light feed of grain in the

litter in the morning; stir it in well so they have to work to find it. At noon open the hopper and let them help themselves until about four o'clock, when it should be closed and the hens fed an abundant feed of grain. If some grain is left in the litter they will search it out the next morning. If moist mash is fed it should be given at noon and then in moderation as the hens are very fond of warm, crumbly mash in cold weather, and may engorge their crops if fed too much. Aim to have a constant supply of fresh water. Do not allow the fowls to get too hungry but endeavor to keep them comfortable, busy and contented. By strict adherence to these rules one should be able to make the strong, vigorous pullets lay well all the fall and winter.

INTRODUCTION.

This bulletin had its origin in a plan of handling starters designed by this department for the short course students in dairying. Mr. W. R. Wright, now of Stillwater, Okla., employed it in his class work and Mr. L. D. Bushnell has carried on the work to the present time. Both have contributed in various ways to its improvement and have made every effort to render it of practical value to the butter- and cheese-maker. Much credit is due to Mr. F. O. Foster in confirming its application to dairy practices.

Having had the method set forth in this bulletin under consideration and investigation for four years, and having found it safe, we have no hesitancy in recommending it to every butter- and cheese-maker who is able to appreciate what a good starter is and, further, has it in him to appreciate what it means to manipulate a starter.

CHARLES E. MARSHALL.

PRACTICAL USE OF STARTERS.

L. D. BUSHNELL AND W. R. WRIGHT.

Bulletin No. 246.

Dairy methods have undergone great changes in the past decade, due in a large part to the discoveries in bacteriology.

Micro-organisms play a very important part in milk management because they are constantly found in all milks ordinarily produced and are responsible in a large part for many milk changes, such as bad flavors, bad odors, gases, and souring, which changes are proportional to the cleanliness observed in the handling of milk and cream. Some of the micro-organisms present are essential to some of the stages in the processes of butter- and cheese-making. It follows that some micro-organisms are to be eliminated in one way or another in order to prevent unfavorable conditions arising, while there are some that should be fostered and cultivated because they are necessary in the ripening of cream for butter and of milk for cheese. Micro-organisms, as many plants, suffer at times and are favored at times by certain associations. Some plants favor other plants by growing with them; again these same plants may antagonize still others. Micro-organisms are useful to the growth of other micro-organisms at times and at other times antagonistic, depending upon the kinds brought together and the conditions under which they are associated. Should, therefore, a suitable micro-organism be found necessary or desirable for the manufacture of the milk product and also antagonistic to obnoxious micro organisms, much could be gained by fostering or cultivating it.

A growth of micro-organisms in a suitable food substance as milk, whey, or beef tea, is called a culture. If only one species of micro-organism be present the growth is called a pure culture; but if two or more be present the growth is called a mixed culture. For us to be thoroughly familiar with a starter we must understand a culture, because a starter as used in dairy operations is generally a culture containing one species of micro-organisms. In some few instances where two or more micro-organisms are found that harmonize in their modes of growth, a mixed culture is used, thereby perhaps bringing about better results than when developed separately. The starter is used to overcome obnoxious micro-organisms and adds to the finished product the desired flavor, aroma, keeping quality and perhaps other essential properties.

Classes of Starters.—Starters are of two general classes, viz., natural and commercial.

The Natural Starter.—Under the head of natural starters are placed all those originating at home, usually by selecting and setting aside until loppered a quantity of carefully drawn milk. Buttermilk, whole milk, sour cream, and whey are sometimes used in this capacity. A starter produced in this way may contain several species of micro-

organisms. Thus it is not difficult to understand why a starter produced by natural souring may develop taint or become gassy.

The Commercial Starter.—The commercial starter is generally developed from a single micro-organism and is built up as a pure culture or a known mixed culture. This class includes those starters originated and offered for sale in solid or liquid form by various commercial firms. Though the different brands differ more or less as to activity at a given temperature as well as in the flavor imparted to butter or cheese, yet from the very fact that these are pure cultures, uniform growth and acid production may be expected. This being the case, a commercial starter is kept free from contaminations and, developed under the same conditions, may be used for an indefinite time and produce an unvarying product.

Comparison of the Natural with the Commercial.—It is essentially true that a pure culture of micro-organisms will hold its quality much longer than one having several species present; it follows that a commercial starter will give more constant results than the natural.

Sterilization.—This term means the destruction of micro-organisms present. Under this head comes sterilization by the use of heat, chemicals, filters, and other means.

Heat is the agent most commonly used for this purpose. It may be employed to destroy all micro-organisms present (sterilization) or only a part (pasteurization). There are several purposes which we may desire to accomplish by the use of heat. 1. To destroy all micro-organisms present, thus leaving a clear field for the action of any particular species added as in the case of pure culture starters. 2. To destroy those micro-organisms which cause souring and like fermentative changes.

The former usually renders the milk unpalatable for use as food, because of the cooked flavor; consequently, in the case of cream for butter and milk for cheese, pasteurization is employed.

This treatment consists in heating the milk to a temperature of 145° to 185° F. and then rapidly cooling to below 100° F. Sush pasteurization generally kills from 95% to 99% of all the bacteria present. Though the remainder constitute a small percentage of those originally present, they are vigorous growers, and with every transfer of the starter their numbers are increased. If a sufficiently high temperature is employed all the bacteria are destroyed at once. But since some of the common milk bacteria have a spore or seed stage, which stage is very resistant to heat, a discontinuous method is used whereby heat is applied for thirty minutes each day to pint bottles and forty-five minutes each day to quart bottles for four consecutive days. The milk in the meantime being kept in a warm room to hasten the development into a form more easily killed by heat. If the latter method is employed we get a perfectly sterile condition. A pure culture added to this and allowed to sour gives a pure culture of desirable bacteria which will give uniform results for an indefinite period if properly handled.

This being the present condition, it seems that a method of handling a starter which insures a permanent quality, and at the same time which lessens the actual expense for starters will be of interest to many. It is due to this fact that an attempt has been made in the

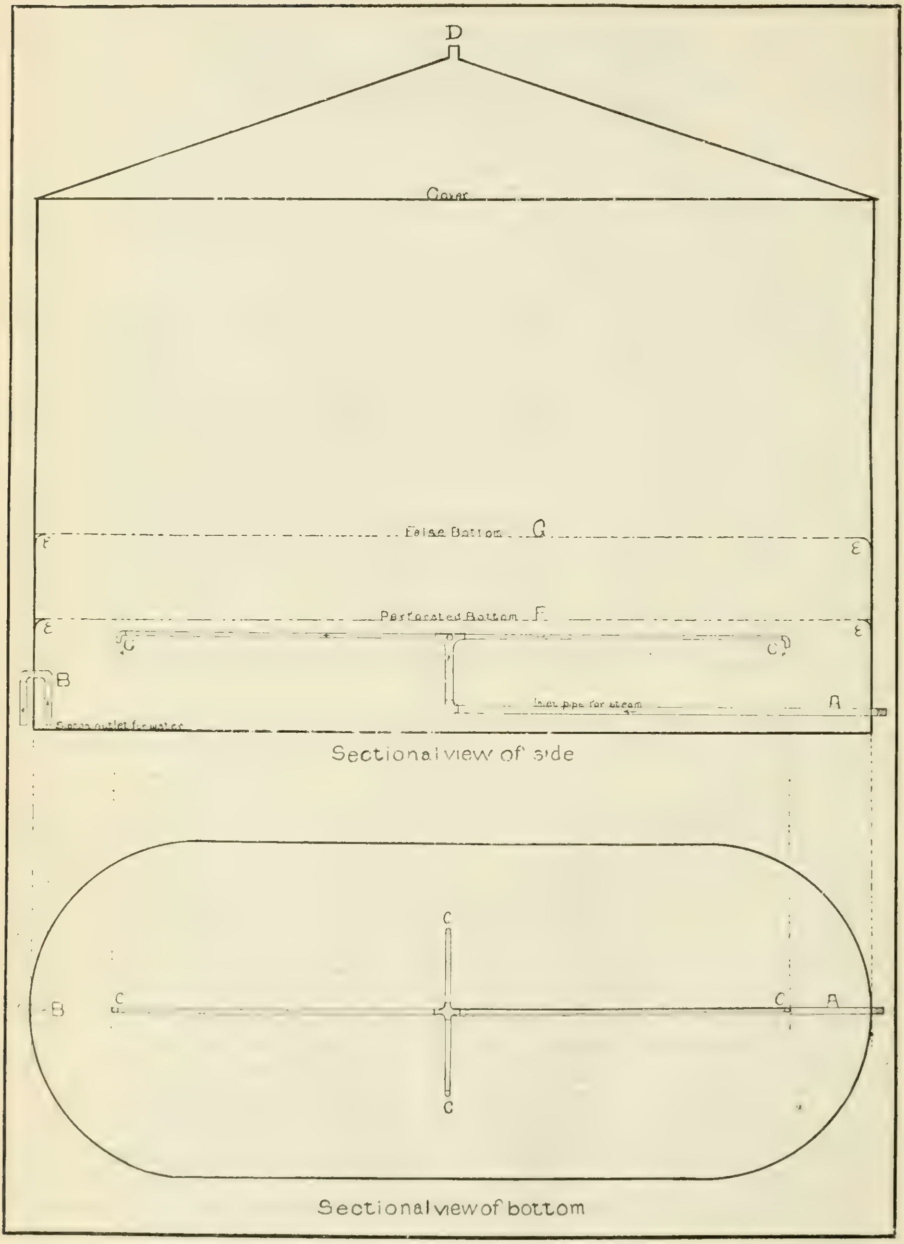
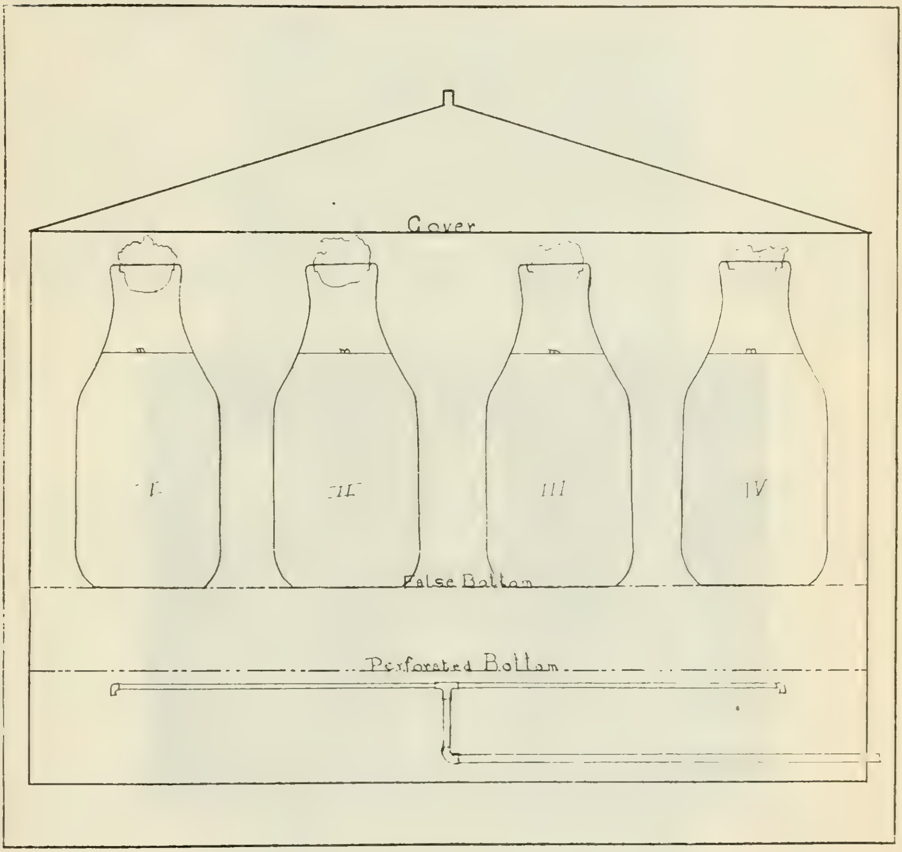

D
Cover
False Bottom G
Perforated Bottom F
B
Inlet pipe for steam
A
Sectional view of side
C
B
A
Sectional view of bottom

FIG 1.

following pages to describe handling and management of starters by the sterilizing or absolute method.

The Sterilizer.—As sterilization is to replace pasteurization in this process, a steam sterilizer is a necessary piece of apparatus and Fig. 1 has been inserted mainly to show the parts of a serviceable sterilizer. A common copper wash boiler may be fitted up for sterilizing pur-



Sectional view of side showing bottles in place

FIG. 2.

poses in much the same way, or a box constructed of wood or of galvanized iron may be used.

A more detailed explanation may prevent errors on the part of those who set up sterilizers in their factories. The inlet, A, should be placed near the bottom and of the proper size to fit a steam jet. The siphon tube, B, for the removal of condensed water, always has its inner end covered, thus preventing loss of steam. The highest point of the outlet should be lower than the opening C, so that steam upon entering will not have to pass through water. For the supports E, some light material should be used, as heavy metal or solid bodies

condense large quantities of steam; the perforated bottom, F, should have numerous openings to permit the free upward movement of steam; G, should be of wire netting. This causes a more uniform distribution of steam, thereby preventing many breakages.

As all factories are not supplied with apparatus for the production of steam, a substitute may be made on the plan of an ordinary steam cooker with an inch or two of water in the bottom. When this plan is used sterilization begins when the steam begins to issue from the openings. A thermometer placed in the opening, D, should register 210° F.

Filling and Sterilizing.—In Fig. 2 the four jars, 1 to 4, are filled with milk to the line, m, and the mouth of each filled with a dry firm cotton plug. The plugs should, under all conditions, be kept dry. Trouble may be anticipated in attempting to sterilize these thick glass jars; but if a few precautions are taken there need be but few breakages. A shield (F in Fig. 1), placed so as to prevent hot water and steam from striking the glass jars, and a wire gauge or window screen for them to stand upon, insures almost any glass jar against destruction by unequal heating.

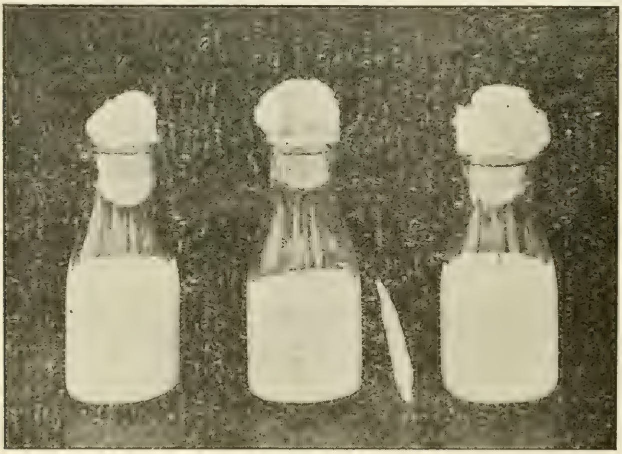


Fig. 3.

The exact period of time to heat cannot be given, for much depends upon the steam pressure or upon the vigor with which the water is boiled. Tests may be made with a thermometer to determine this point. If kept at 210° F. for 30 or 40 minutes at each period for four consecutive days, sterilization will be effected in case of small quantities of milk. This, however, depends upon the amount of milk in each bottle.

A test for jars of milk supposed to be sterile may be made by placing them in a warm room, for a few days. If no visible change takes place we are practically assured in saying that the milk is sterile.

Inoculating and Developing.—The culture of lactic organisms may be introduced as directions on the package indicate, but using every precaution to prevent any of the material from coming in contact with

the hands, neck of the jar, or other objects. If these precautions are not exercised the benefit to be gained from the use of sterile milk will not materialize. Under no condition should the cotton plug of a jar be removed after the first heating, except when about to introduce the starter, and then not longer than four or five seconds.

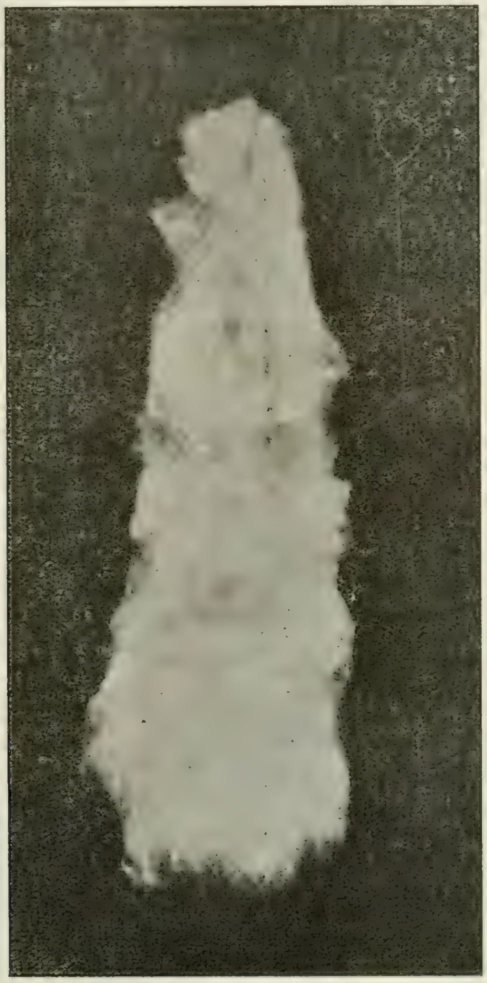


FIG. 4.

There are several factors which influence the time required for loppering, viz., temperature, activity of starter, and quantity introduced. In order to have a culture at the proper stage when needed the temperature may be changed or the amount of the inoculating culture raised to meet the requirements. Nothing but experience will determine these points.

FIG. 5.

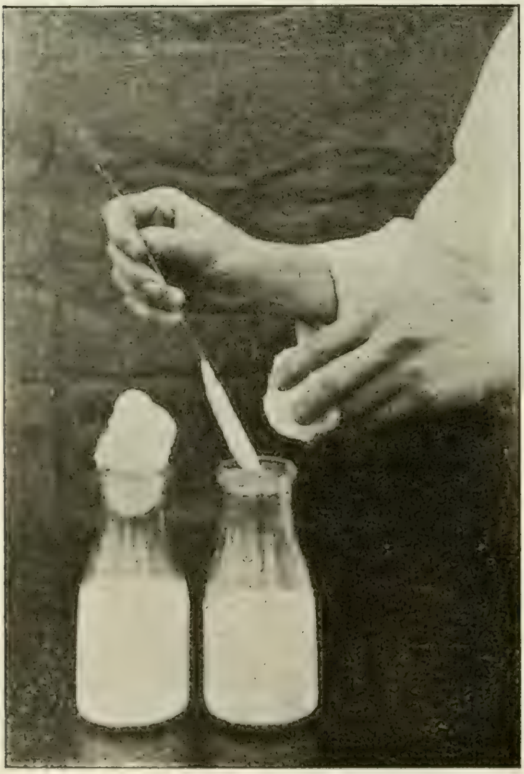


FIG. 6.

Transferring the Starters.—The starter, to be successful, must be transferred daily and some inexpensive transferrer must be devised to meet all requirements. The operator, in order to make successful transfers, must have something that will convey the proper amount, be easy of sterilization, have relative freedom from contamination, and convenience in handling. A vial with a wire handle, a piece of cloth wound loosely about a wire handle, or a small amount of cotton wound firmly about a wire, as shown in Fig. 3, are some transferring tools easily made, and fully meeting all requirements. Of these transferrers, the latter seems best fitted for all practical purposes. It is easily constructed by taking a wire which has been made rough on one end

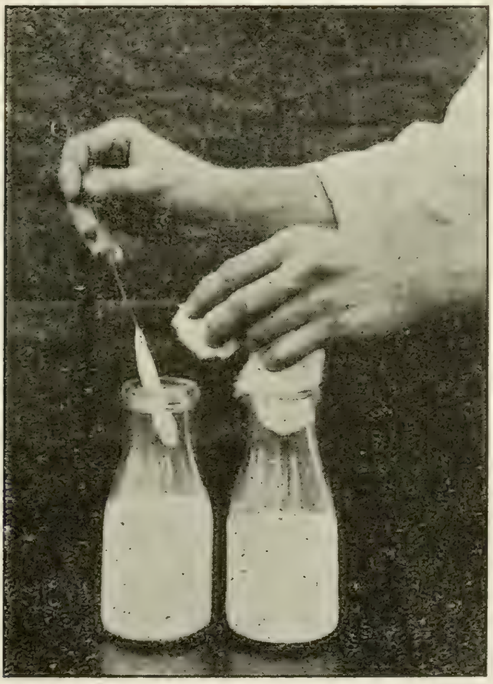


FIG. 7.

and some loose cotton batting as shown in Fig. 4. The cotton is wound firmly around the wire by holding between the thumb and first and second fingers, as shown in Fig. 5.

The transferrer should be placed in the milk before sterilization begins and should never be removed until ready for the transfer.

After inoculation and loppering, a safe transfer may be made by removing the plugs of both bottles and lifting this transferrer very carefully from the loppered milk and placing it in the sterile milk, *care being taken not to allow the swab to come in contact with anything during the operation.* The plugs should not be transferred from one bottle to another, but should be removed as shown in Figs. 6 and 7.

If a large can of recently pasteurized milk has been cooled below 100° F., the contents of the jar from which the transfer was made may be emptied into it, thus completing the work of preparing a starter for use on the following day for ripening large quantities of cream. By this method only a quart of milk out of a large can of starter has been sterilized, a quantity too small to be detected in the cream or butter.

To meet the needs of the busy creamery man, a table of daily directions in short form, follows. The directions will call the attention of the beginner to operations necessary to the successful management of starters by the sterilizing method. This is a simple and easy method to follow. A very convenient method is to sterilize several bottles at a time and put in a cool place for future use. In this way enough can be sterilized at one time to last a month or more.

Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
*1. Prepare and sterilize Jar 1.	1. Prepare Jar 2, and sterilize Jars 1 and 2.	1. Prepare Jar 3, and sterilize Jars 1, 2, 3.	1. Prepare Jar 4, and sterilize Jars 1, 2, 3 and 4. †2. Introduce a commercial culture of lactic germs into Jar 1 and place it at the proper temperature to develop.	1. Prepare Jar 5, and sterilize Jars 2, 3, 4 and 5. 2. Pastuerize an 8 gallon can of separated milk. 3. Transfer from Jar 1 to Jar 2. †4. Empty contents of Jar 1 into the can of pastuerized milk.	1. Prepare Jar 6, and sterilize Jars 3, 4, 5 and 6. 2. Pastuerize an 8 gallon can of separated milk. 3. Transfer from Jar 2 to Jar 3. 4. Empty the contents of Jar 2 into the can of recently pastuerized milk. 5. Use the ripened can of milk prepared Friday as a starter for sweet cream.

* In preparing Jar 1 the transferrer should not be omitted.
† No transfer should be made until milk is below 100° F.

L. D. BUSHNELL and W. R. WRIGHT.

The method of carrying mother starters in sterilized milk in glass jars has been given a thorough trial in practical work in the College creamery in comparison with the method commonly employed, which is to inoculate a starter each day from the one prepared the preceding day. The new method has the following advantages:

The starter can be kept pure for a much longer period, thus saving one-half or more of the cost of pure cultures.

The milk is always ready for inoculation and the mother starter can be transferred each day when in the best condition and kept vigorous.

In case a starter is not needed every day, the mother starter can be carried along conveniently without the trouble of sterilizing milk.

After a thorough trial we have adopted the method for our daily use. We find it no great task to sterilize the bottles of milk once or twice a month, and the little extra labor thus occasioned is more than offset by the convenience and sureness of the new method.

F. O. FOSTER,
Instructor in Dairying.

DRIED BEET PULP FOR FATTENING STEERS.

R. S. SHAW AND H. W. NORTON, JR.

Bulletin No. 247.

With the development of the beet sugar industry in this state, dried beet pulp has been placed on the market in large quantities and recommended for feeding purposes. Much of it has been used by stockmen and feeders throughout the state and many questions have been asked regarding its feeding value. Dried beet pulp is a by-product of the beet sugar factory and consists of the refuse pulp which has been dried sufficiently to expel the greater part of the moisture content, so that it can be placed upon the market and handled with other feeds.

Its analysis, as compared with corn meal, given in Michigan Bulletin 234, is as follows:

Dry matter and digestible material in one pound:

	Dry Matter.	Protein.	Carbohydrates and Fat.	Nutritive Ratio.
Dried beet pulp............	.901	.075	.614	8.1
Corn meal	.894	.078	.772	9.8

The protein content is very nearly the same in the two, but the carbohydrates and fat, especially the latter, are considerably higher in corn meal. It would, however, be classed with corn meal as a fattening food according to chemical composition. Several tests have, therefore, been carried on at this station for the purpose of securing information relative to its value for various feeding purposes. Bulletin 220, of this station, treats of the value of dried pulp for fattening sheep. In the tests reported, both plain dried and dried molasses pulp were used against corn, and the conclusions reached were:

(1) Both dried beet pulp and dried molasses beet pulp are possessed of feeding values comparing very favorably with corn.

(2) Grain mixtures containing dried beet pulp produce mutton at a less cost than similar amounts of grain mixtures alone.

In the tests reported herein, comparisons have been made of the feeding values of dried beet pulp and corn meal for fattening steers. Three trials are reported. In the first, during the winter of 1904 and 1905, only two lots of steers were used, one lot receiving beet pulp in the grain ration, the other receiving corn meal. In each of the two later tests, January to May, 1906, and August to December, 1906, a third lot was entered and received a combination grain ration, consisting of equal parts by weight of the grain mixtures fed to the other two lots.

Table of values used in all three trials:

Corn meal	$20 00 per ton
Dried beet pulp	15 00 " "
Oil cake	28 00 " "
Silage	2 50 " "
Clover hay	5 00 " "

Feeding Trial No. 1.

In the first test, which covered a period of 84 days extending from December 2, 1904, to February 23, 1905, nine steers were used. They were bought in Chicago at a cost of $3.80 per cwt., averaging 912 lbs., and graded on the market as medium feeders. The steers were stall fed as in the two later trials in order that accurate individual records might be kept. During the day they were turned out in small yards, where they had access to water. They were weighed three successive days, both at the start and close of the experiment proper. In the preliminary feeding period they were placed on their regular feeds and gradually brought up to a full ration. This preliminary covered 19 days, which was considered a sufficient length of time to fill the steers up and offset any shrink due to shipping and change of feed before the test proper began.

RATIONS.

Lot 1—Grain mixture composed of corn meal 5, oil cake 1, and clover hay.

Lot 2—Grain mixture composed of dried beet pulp 5, oil cake 1 and clover hay.

Lot 1 consumed throughout the feeding period an average per head per day as follows:

7.86 lbs. corn meal.
1.56 lbs. oil cake.
9.68 lbs. clover hay.

The average cost of the daily ration per head for this lot was 12.46 cents.

Lot 2 consumed per head per day:

8.00 lbs. dried beet pulp.
1.58 lbs. oil cake.
9.67 lbs. clover hay.

The average cost of the ration per head daily being 10.63 cents or 1.83 cents less than the cost for Lot 1, fed on corn meal.

WEIGHTS AND GAINS.

	Lot 1. Corn Meal Lot. lbs.	Lot 2. Beet Pulp Lot. lbs.
Average weight December 2, 1904	983.9	978.9
Average weight February 23, 1905	1,072.5	1,078.4
Average gain	88.6	99.5
Average gain per head daily	1.05	1.18

This table shows an increased gain for the pulp lot over the corn meal lot amounting to .13 lb. per head daily. This larger gain, together with the lesser cost of the daily ration, as mentioned above, allows a much cheaper production per pound of gain in live weight for the steers on the pulp ration. In this trial Lot 1, the corn meal lot, gained at a cost of 11.82 cents per lb., and Lot 2, the pulp lot, gained for 8.97 cents per lb., a margin of 2.85 cents per lb. in favor of the beet pulp ration. There was a noticeable difference, however, in the condition shown by the steers of the two lots. The corn meal steers were much fatter at the end of the feeding period and showed more finish and a smoother, riper covering than the pulp fed lot, which seemed to put on its gain more in form of growth and was rougher and lacking in finish.

Feeding Trial No. 2.

The second trial extended over a period of 112 days, from January 17 to May 8, 1906, four weeks longer than the preceding trial. The animals used were one pure bred yearling Hereford heifer, a cross-bred Shorthorn-Holstein steer calf about nine months old at the commencement of the test, and ten calves from the College Grade Dairy Herd. These calves, which were mostly grade Shorthorns, had been raised on skim-milk with supplementary feed consisting of silage, clover hay, and a grain ration consisting of corn meal, ground oats, bran, and oil cake. They had been fed more with a view to growth than finish, so that at the outset they showed very little fat. The average age for these ten was about one year at the start of the test.

The twelve animals were divided into three lots as nearly alike as possible from a standpoint of condition, quality, and weight. The Hereford heifer was placed in Lot 1; the Shorthorn-Holstein steer in Lot 2.

In the preliminary feeding period which covered four weeks, preceding the test proper, all were fed alike on silage and clover hay for roughage with the grain ration of Lot 2, namely, corn meal 5, beet pulp 5, oil cake 4. In the test the lots were fed as follows—all had silage and clover hay for roughage:

Grain rations—

Lot 1—Corn meal 5, oil cake 2, parts by weight.
Lot 2—Corn meal 5, dried beet pulp 5, and oil cake 4 parts by weight.
Lot 3—Dried beet pulp 5, oil cake 2 parts by weight.

The prices used in figuring the feed were the same as in the earlier trial.

The tables following show the actual amounts of feed consumed by each lot and the value of same.

Feed consumed by each lot in 112 days:

	Silage. lbs.	Hay. lbs	Grain. lbs.	Cost.
Lot 1. Corn meal lot..................	5372.0	1018.0	3317.0	$46.211
Lot 2. Corn meal and beet pulp lot......	5372.0	1019.0	3515.0	45.290
Lot 3. Beet pulp lot....................	5372.0	1018.0	3212.0	39.292

The average feed of silage per head daily throughout the experiment was 12.0 lbs. in each case, and of hay 2.27 lbs. per head per day.

Lot 1, the "Corn Meal Lot," consumed 7.4 lbs. of grain, Lot 2, the "Corn Meal Beet Pulp Lot," 7.84 lbs., and Lot 3, the "Beet Pulp Lot," 7.16 lbs. of grain per head daily.

The average daily cost of ration was 10.3 cents for Lot 1, 10.1 cents for Lot 2, and 8.77 cents for Lot 3. This places the cost of the daily ration for the Pulp Fed Lot, Lot 3, 1.33 cents cheaper than for Lot 2, and 1.53 cents cheaper than that of Corn Meal Lot.

WEIGHTS AND GAINS.

	Weight Jan. 17. lbs.	Weight May 8. lbs.	Gain. lbs.	Gain per head. lbs.	Gain per head per day. lbs.	Total cost.	Cost per lb. gain.
Lot 1. Corn meal	3112.2	3697.8	585.6	146.40	1.307	$46.211	$0.0789
Lot 2. Corn meal, beet pulp	2855.2	3486.2	631.0	157.75	1.408	45.290	0.0717
Lot 3. Beet pulp	3003.2	3661.6	658.4	164.60	1.469	39.292	0.0596

A study of the above table shows the greatest gains with the "Beet Pulp Lot," second with the "Beet Pulp Corn Meal," and least with the "Corn Meal Lot." It may also be seen that the cost of the ration decreases as its pulp content increases, the pulp being the cheapest factor in the grain mixtures, and as before stated, the cost per head of the daily ration was 1½ cents cheaper with the pulp fed lot than with the corn meal lot. As a result we find the cost of production of a pound of beef was 5.96 cents on the beet pulp ration, while with the Corn Meal Lot one pound cost 7.89 cents, and Lot 2 fed the ration of beet pulp and corn meal together produced a pound of gain for 7.17 cents.

There was considerable discrepancy in the weights of the lots at the start, owing to the two odd animals used to fill up the number,

Lot 1, averaging 778.0 lbs., Lot 2, 713.3 lbs., and Lot 3, 750.8 lbs. at the beginning of the test.

Lot 2, the lightest to start with, was beaten out in gain by Lot 3. This lot stands between Lots 1 and 3, both in gains and cost per pound gain. The amount of grain consumed, however, by Lot 2 was considerably ahead of either of the other two lots, raising the absolute cost of the ration for the whole test nearly to that of Lot 1, the Corn Meal Lot.

CONDITION AT CLOSE OF FEEDING PERIOD.

As in the earlier trial, the corn meal fed animals showed a greater amount of fat and a more finished condition than the Pulp Fed Lot. This difference was quite marked, the corn meal steers showing much thriftier, sleeker coats and smoother covering.

FEEDING TRIAL NO. 3.

The third feeding trial was carried out in the fall of 1906, covering a period of 120 days, from August 11 to December 8. Twelve choice yearling steers, bought on the Chicago market, were used in this test.

Six were Hereford grades and six Shorthorn grades, all showing good compact blocky types and much uniformity as to weight and condition of flesh with a single exception, Steer No. 1, a somewhat larger and more rangy animal than the others. He was placed in Lot 1, the Corn Meal Lot, during the experiment.

The preliminary feeding was started immediately upon the arrival of the steers, all alike receiving during this period the grain mixture fed Lot 2 during the previous feeding trial, namely, corn meal 5, beet pulp 5, and oil cake 4, parts by weight. No difficulty was experienced in getting them on feed, as they had evidently been fed grain before. There was no silage available at that time and the only roughage furnished was clover hay. This preliminary feeding period covered one week when the steers were weighed individually for three successive days, August 10, 11, and 12, at 9:30 a. m., and the average of the three was taken as the correct weight on the middle day, August 11th. This weight was used in arranging the lots for the test.

Weights August 11. Average for three successive days:

Lot 1.

No. 1	945.6 lbs.
No. 2	843.0 lbs.
No. 3	754.3 lbs.
No. 4	686.3 lbs.
Average for Lot 1	807.3 lbs.

Lot 2.

No. 5	802.6 lbs.
No. 6	733.0 lbs.
No. 7	771.3 lbs.
No. 8	888.0 lbs.
Average for Lot 2	798.7 lbs.

Lot 3.

No. 9	654.6 lbs.
No. 10	860.6 lbs.
No. 11	840.3 lbs.
No. 12	843.0 lbs.
Average for Lot 3	799.6 lbs.

In dividing the twelve steers into three lots two Herefords and two Shorthorns were placed in each lot, so that any difference in breeding should not affect the results of the experiment.

Without this factor of breeding to interfere in the division, the lots

might have been arranged a little more evenly in weight; as it was the greatest difference was 8.6 lbs. between Lots 1 and 2.

RATIONS.

The grain rations fed were the same as those used in feeding trial No. 2, namely:

Lot 1—Corn meal 5, oil cake 2.

Lot 2—Corn meal 5, beet pulp 5, oil cake 4.

Lot 3—Beet pulp 5, oil cake 2.

Roughage was supplied in the form of clover hay during the first few weeks of the experiment, but as the supply gave out, mixed hay and timothy were used instead. This was a rather serious drawback, as the steers could not be induced to eat more than two pounds at a feed or four pounds per day.

At the beginning of the sixth week, about the middle of September, silage was added to the ration and they were fed 10 lbs. per head daily until the close of the test.

Grain was fed in as large amounts as would be nicely cleaned up. The average rations for the lots throughout the test were as follows:

Average ration consumed:

Lot 1—Corn Meal Lot.
Hay 3.95 lbs. per head per day.
Grain 11.04 lbs. per head per day.
Silage 10.0 lbs. per head daily (during 11 weeks).

Lot 2—Corn Meal Beet Pulp Lot.
Hay 3.95 lbs. per head per day.
Grain 10.43 lbs. per head per day.
Silage 10.0 lbs. per head daily (during 11 weeks).

Lot 3—Beet Pulp Lot.
Hay 3.95 lbs. per head per day.
Grain 9.84 lbs. per head per day.
Silage 10.0 lbs. per head per day (during 11 weeks).

The amount of roughage fed was kept constant with all three lots throughout the experiment. The amount of grain was limited only to what the steers would consume and shows a regular decrease with the increase in pulp content of the mixture. The Corn Meal Lot consumed 11.04 lbs. of grain per head daily, the Corn Meal Beet Pulp Lot 10.43 lbs. and the Beet Pulp Lot 9.84 lbs. per head daily. This may be considered as a point against the feeding value of beet pulp—that it is too bulky, when used to form the major part of the grain ration, to be fed in sufficient quantity to give the best results for finishing steers.

Total feed consumed by each lot during test:

	Silage. lbs.	Grain. lbs.	Hay. lbs.	Cost.
Lot 1. Corn meal Lot..................	3138	5303	1898	$67.741
Lot 2. Corn meal, beet pulp Lot........	3148	5011	1898	60.039
Lot 3. Beet pulp Lot,..................	3148	4725.5	1898	52.863

The smaller amount of grain consumed by the Pulp Fed Lots, together with lower value of beet pulp as compared with corn meal—beet pulp, $15.00 per ton, corn meal $20.00 per ton—tended to cheapen the ration of the steers receiving the pulp. As shown by the above table, the total cost of feed consumed by the Corn Meal Lot was $67.74, which was $7.70 more than the cost of feed for the Corn Meal Beet Pulp Lot, and $14.88 more than the cost of the Beet Pulp Lot.

The average cost of ration per head daily was 14.1 cents with the Corn Meal Lot, 12.5 cents with the Corn Meal Beet Pulp Lot, and 11.0 with the Beet Pulp Lot, a difference in the cost of ration of more than three cents per head daily between Lot 1 and Lot 3.

Weights and gains of each lot:

	Weight Aug. 11. lbs.	Weight Dec. 8. lbs.	Gain in 120 days. lbs.	Gain per head daily. lbs.	Total cost of feed.	Cost of 1 lb. gain.
Lot 1. Corn meal..............	3229.2	4208.1	978.9	2.039	$67.741	$0.0690
Lot 2. Corn meal, beet pulp....	3194.9	4017.2	822.3	1.713	60.039	0.0730
Lot 3. Beet pulp..............	3198.5	4000.2	801.7	1.670	52.863	0.0659

The greatest gain made during the feeding period was that of the Corn Meal Lot, 978.9 lbs., or a little more than 2 lbs. per head daily. The Beet Pulp Lot gained the least, 801.7 lbs., or 1.67 lbs. per head daily, nearly equaling Lot 2, which gained 1.71 lbs. daily. The Corn Meal Lot led the Beet Pulp Lot by a margin of 177.2 lbs. in gain, but even that could not offset the difference in cost of ration. The gains made by the Corn Meal Lot cost 6.9 cents per lb., while the Beet Pulp steers gained for 6.59 cents a difference of 31 cents per hundred weight in favor of the Beet Pulp steers. Lot 2, fed on the combination ration of beet pulp and corn meal, produced gain at a cost of 7.3 cents per lb., a considerably higher figure than either of the other two lots. From the previous trial we should expect Lot 2 to gain cheaper than the Corn Meal Lot, but at a higher cost than the straight Beet Pulp Lot, as in the second feeding trial the Corn Meal Beet Pulp Lot stood practically half way between the other two, both in actual gain and in cost per lb. gain. In the first feeding trial none of the steers received the ration of corn meal and beet pulp together, so that no comparison is available. The failure of the Corn Meal Beet Pulp Lot to make proportionate gains in this test

brought the cost up above both Lots 1 and 3. This result can only be attributed to the individuality of the steers of that lot.

As in the other two trials, the corn meal fed steers carried the most fat and showed the best condition of finish.

Summary of Results.

In making averages only the Corn Meal Lots and Beet Pulp Lots are considered, as trial No. 1 consisted of but these two.

AVERAGE GAIN PER HEAD DAILY.

	Corn Meal Lot. Av. daily gains	Corn Meal, Beet Pulp Lot. Av. daily gains	Beet Pulp Lot. Av. daily gains
Feeding trial No. 1	1.053 lbs		1.184 lbs
Feeding trial No. 2	1.307 lbs	1.408 lbs	1.469 lbs
Feeding trial No. 3	2.039 lbs	1.713 lbs	1.670 lbs
Average	1.466 lbs		1.441 lbs

In trials 1 and 2 the rations containing pulp produced the greatest gain, but in the last trial this was reversed—the Corn Meal Lot gained the most, next the Corn Meal Beet Pulp Lot, and last the straight beet pulp ration. In the two earlier tests the animals used were in a growthy condition and were poor in flesh. The steers in the last trial were in very good condition when the test began, carried a fairly thick covering of flesh and were ready to be fed a finishing ration. As a result the Corn Meal Lot showed up best in gains, while in the earlier tests where the steers were less inclined to fatten readily and finish when put in the test, the pulp lots made the greatest gains. This would seem to substantiate the previous statement that the gain produced by feeding beet pulp is in the form of growth and development rather than in the form of fat.

AVERAGE COST OF DAILY RATION.

	Corn Meal Lot.	Corn Meal Beet Pulp Lot.	Beet Pulp Lot.
Feeding trial No. 1	12.4 cts.		10.6 cts.
Feeding trial No. 2	10.3 cts.	10.1 cts.	8.7 cts.
Feeding trial No. 3	14.1 cts.	12.5 cts.	11.0 cts.
Averages	12.26 cts.		10.1 cts.

The daily ration was cheaper in each case for the Beet Pulp Lots than for the Corn Meal, the average being 12.26 cents per head daily for the corn against 10.1 cents daily for the pulp, a difference of 2.16 cents per day in favor of the latter.

AVERAGE COST PER CWT. GAIN.

	Corn Meal Lot.	Corn Meal, Beet Pulp Lot.	Beet Pulp Lot.
Feeding trial No. 1	$11.82		$8.97
Feeding trial No. 2	7.89	$7.17	5.96
Feeding trial No. 3	6.90	7.30	6.59
Averages	8.87		7.17

In every case the pulp feed steers gained at a less cost than the corn meal steers, the average being $8.87 per cwt. gain when fed the corn meal ration as against $7.17 per cwt. gain when fed the beet pulp ration, a margin of $1.70 per cwt. in favor of the beet pulp for cheapness of gain.

The conclusions to be drawn from these three feeding trials, in comparison of dried beet pulp and corn meal for fattening steers are:

1. Beet pulp produced gain cheaper than corn meal. The average cost per cwt. gain for the steers fed corn meal was $8.87, and for beet pulp was $7.17, $1.70 per cwt. cheaper with the dried beet pulp ration.
2. The absolute gains produced by feeding beet pulp were practically the same as from feeding corn meal.
3. The gains of the pulp fed steers were in the nature of growth and development, the corn meal produced fat and finish. As a result, at the end of the feeding period, the corn meal steers were in better condition for market than the others.
4. For growing animals, beet pulp produced the greatest gains. For animals in a condition for finishing corn meal gave the most rapid gains.

From this it would be safe to conclude that in the earlier part of the feeding period, beet pulp could be fed in a larger quantity to advantage, because of its cheapness and at the same time ability to produce gain rapidly. During the finishing period it should, however, be replaced at least in a large measure by corn meal, which possesses more value for finishing purposes. The corn meal is a much more concentrated feed, hence its especial value for forcing at the close of the feeding period when beet pulp could not be used on account of the bulky character rendering it impossible to feed sufficient quantity for the best results. These trials show that a thousand-pound steer will not consume over 10 lbs. of dried beet pulp in a day.

SPRAYING CALENDAR.

L. R. TAFT, *Horticulturist;* C. D. SMITH, *Director.*

[Special Bulletin No. 36.]

Farmers and fruit growers are beginning to understand the importance of the use of insecticides and fungicides to preserve their crops from the attacks of insects and diseases. To supply information as to the best remedies and the methods of preparing and using them, in a form that can be preserved so as to be convenient for reference, the following bulletin has been prepared. The remedies have been thoroughly tested, and if the directions regarding their preparation and application are carefully followed, they will be found effectual and can be used without danger to the foliage and fruit, or the health of the consumer.

Explanation.—While the entire number of applications given will be found desirable in seasons when insects and fungous diseases are particularly troublesome, and in the case of varieties that are subject to attack, a smaller number will often suffice. To indicate those that are of greatest importance, italics have been used, while others, that, although seldom required, may sometimes be of value, are printed in plain type. Whenever an asterisk (*) is used, it cautions against spraying trees with poisons while they are in blossom.

Plant.	First application.	Second application.	Third application.	Fourth application.	Fifth application.
APPLE: (*Scab, codling moth, bud moth, canker worm, tent caterpillar, aphis*).	Spray before buds start, using copper sulphate solution. *For San Jose scale or aphis use the sulphur and lime mixture.*	*After the blossoms have formed, but before they open spray with Bordeaux mixture and Paris green.**	*Within a week after the blossoms fall, Bordeaux and Paris green.**	10-14 days later, Bordeaux and Paris green. Repeat, if necessary.	*Spray fall and winter varieties with Bordeaux and Paris green about the first of August.*
CABBAGE: (*Worms, aphis and flea-beetle*).	*When worms are first seen, Paris green. For flea-beetles plaster and turpentine, or tobacco dust.*	*If worms reappear, repeat if plants are not heading.*	*After heads form, use hot water, pyrethrum, (or saltpeter a teaspoonful to a gallon of water).*	Repeat if worms reappear. For aphis use kerosene and water mixture.	(NOTE.—For the oyster-shell scale on the apple, spray with lime whitewash and lye after the leaves drop.)
CHERRY: (*Rot, aphis, curculio, slug and leaf blight*).	*Before the buds open spray with copper sulphate.*†	*When the fruit has set, spray with Bordeaux mixture and Paris green.**	10-14 days later, if slugs or signs of rot appear, repeat.	10-14 days later, weak copper sulphate solution if necessary, or soda Bordeaux.	For leaf-blight use Bordeaux mixture after the crop has been gathered.
CURRANT: (*Mildew, worms, borers and leaf blight*).	*When pruning cut out all stems that contain borers. As soon as worms are found on lower and inner leaves, spray with Paris green.*†	*If worms reappear, repeat adding Bordeaux for mildew and leaf spot.*	If worms still trouble, pyrethrum or hellebore.	After fruit is picked Bordeaux for leaf spot.	
GOOSEBERRY: (*Mildew, leafblight and worms*).	*As leaves open, Bordeaux and Paris green.*†	*In ten to fourteen days repeat with both.*	*10-14 days later use sulphide of potassium on English varieties.*	*10-14 days later, repeat.*	If mildew persists after crop is gathered repeat.
GRAPE: (*Rot, mildew, anthracnose, flea-beetle and leaf-hopper*).	Before buds burst, spray with copper sulphate solution. Add Paris green for leaf beetles.	*When first leaves are half grown, Bordeaux and Paris green. For leaf-hoppers use kerosene emulsion.*	*When fruit is set use Bordeaux and Paris green.*	If necessary use Bordeaux at intervals of 10 to 14 days.	For powdery mildew use sulphide of potassium.
PEACH, APRICOT: (*Leaf curl, curculio, mildew and rot*).	*Before April 1, spray with copper sulphate solution.*†	*When fruit has set, use Bordeaux mixture and Paris green, one-half strength.*	10-14 days later repeat.	If rot appears, use weak copper sulphate solution.	Repeat if necessary.
PEAR: (*Leafblight, scab, slug and codling moth*).	Before buds open, copper sulphate solution.†	*When the blossoms have formed, but before they open, Bordeaux and Paris green.*	*Within a week after the blossoms fall, Bordeaux and Paris green.**	Repeat in ten or twelve days, if necessary.	Use weak copper sulphate solution, or soda Bordeaux.
PLUM: (*Curculio, rot, shot-hole fungus, black-knot*).	*Cut and burn black knots whenever found. Before buds open, spray with copper sulphate solution.*†	*As soon as the blossoms have fallen, use Bordeaux mixture and Paris green.*	*10-14 days later, repeat.*	Repeat if necessary, at intervals of 15-20 days, or use soda Bordeaux.	After fruit begins to color, use weak copper sulphate solution should rot appear.
POTATO: (*Blight, beetles and scab*).	*Soak seed for scab, in corrosive sublimate (two ounces to sixteen gallons of water), for ninety minutes.*	*When beetles or their larvae appear, Paris green and lime water, or Bordeaux mixture.*	*Repeat whenever necessary.*	For leaf blight use Bordeaux, beginning when the plants are eight inches high.	Repeat every week or ten days if necessary.

Plant.	First application.	Second application.	Third application.	Fourth application.	Fifth application.
QUINCE: (*Leaf and fruit spots, slug*).	*Before the buds open, spray with copper sulphate.*†	*When the fruit has set, Bordeaux and Paris green.*	10-12 days later, repeat.	10-20 days later, Bordeaux.	
RASPBERRY, BLACKBERRY: (*Anthracnose, rust cricket, slug and galls*).	*Cut out galls, crickets and canes badly diseased with anthracnose.* Before buds open, spray with copper sulphate solution.	*When new canes are one foot high, Bordeaux and Paris green.*	10-14 days later, repeat.	After crop is gathered remove old canes, thin new ones and spray with Bordeaux if necessary.	(NOTE.—If red rust appears the entire stool affected should be grubbed out and burned.)
STRAWBERRY: (*Rust and leafeating insects*).	*Just before blossoms open, Bordeaux and Paris green.*	After the fruit has set use Bordeaux mixture.	As soon as berries are harvested, Bordeaux (if to be kept longer).	(NOTE. — Young plantations should receive first and third treatments given to bearing plants).	(After harvesting mow and burn over the bed, especially if leaf rollers are found.
TOMATO: (*Rot and blight*).	*If either disease appears, Bordeaux.*	*Repeat if disease continues.*	Repeat if necessary.		

† For the San Jose Scale upon apple and other trees use the sulphur and lime mixture. This is the best remedy for all scale insects, peach-leaf curl, aphides, on fruit trees, twig borers, pear psylla, pear blister mite, etc.

FORMULAS.

BORDEAUX MIXTURE.

Copper Sulphate	2 to 4 pounds
Fresh Lime (unslaked)	4 to 6 pounds
Water	50 gallons

Care should be taken that the lime is of good quality and well burned and that it has not become air-slaked. If only a small amount is to be slaked it will be best to use boiling water, and the lime should not be allowed to become dry while slaking. When much Bordeaux is to be prepared, it is a good plan to make up stock solutions which can be mixed as required, proceeding as follows: Dissolve 40 pounds of copper sulphate in 40 gallons of water and in a box slake 60 or more pounds of lime. These can be kept for some time, but it is best not to prepare more than can be used in a week or ten days. Each gallon of the solution will contain one pound of the copper sulphate, and in preparing it for spraying, as many gallons should be used as are necessary to furnish the proper amount of copper sulphate. Thus for each 40 gallons required, 2 to 4 gallons of the solution should be placed in a barrel in which there are 16 gallons of water. An equal weight of lime, as near as can be estimated, should be placed in another barrel and 20 gallons of water added to this. After being well stirred, the lime mixture should be allowed to stand for a minute to give the coarse particles time to settle, and then the lime-water should be dipped out and slowly poured into the copper sulphate solution, stirring rapidly as the lime water is poured in. The mixture is then ready for use, but as there is danger of burning tender foliage if the amount of lime is insufficient, it is well to use some simple test, such as dipping a knife blade in the mixture, or adding a few drops of ferro-cyanide of potassium (yellow prussiate of potash). If the amount of lime is not sufficient, copper will be deposited upon the knife blade, while, the ferro-cyanide of potassium will give the mixture a deep brownish-red color. More lime should be added if necessary until no discoloration is caused in either case. An excess of lime will do no harm and is always desirable.

The copper sulphate can be easily dissolved, if suspended in the water in a coarse sack or basket. If the lime is properly slaked and is handled as recommended, there will be little trouble from lumps, but it is always well to strain the lime-water through a sieve, such as a piece of window screening.

This is the best remedy for fungous diseases except while the trees are dormant, or as the fruit is ripening. It is especially valuable for use with Paris green and other arsenites, as it lessens the danger of their injuring the foliage and the washing effect of rains.

DUST SPRAYS.

Attempts have been made to use copper sulphate and Paris green as dust sprays. Very unsatisfactory results have been secured when the dust sprays are used as fungicides but they answer fairly well against the codling moth and curculio, especially as the cost of the applications is much less than for liquid sprays. However, as the injury done by fungi is often greater than that by insects and it is always desirable to use Bordeaux mixture in liquid form, there will be little or no occasion for applying dust sprays of arsenites as they can be readily added to the liquid Bordeaux mixture.

SODA BORDEAUX.

Concentrated lye	1 pound
Lime	5 ounces
Copper Sulphate	3 pounds
Water	50 gallons

Dissolve the copper sulphate and lye, and slake the lime in two gallons of hot water for each; mix the lime and copper sulphate solution and after adding the lye solution dilute to 50 gallons.

This is used upon the grape for the black rot and upon other fruits just before they are ripe.

COPPER SULPHATE SOLUTION.

Copper Sulphate	2 pounds
Water	50 gallons

For use before the buds open the above solution is fully as effectual as Bordeaux mixture and is easier to prepare and apply, but it should not be applied to any plant after the buds have opened. For use against the leaf curl of the peach this solution is especially desirable. If used before the middle of April a thorough application will entirely prevent the attack.

WEAK COPPER SULPHATE SOLUTION.

Copper Sulphate	1 pound
Water	150 to 200 gallons

A solution of copper sulphate of this strength can be used with safety upon nearly all plants. The stronger solution can be used upon all fruit trees except the peach, for which a weak solution would be preferable. Although less effective than Bordeaux mixture, the weak solutions of copper sulphate may be used to advantage where it is not desirable to apply mixtures containing lime. They seem fully as effectual as the ammonia solutions and are much cheaper.

POTASSIUM SULPHIDE.

Potassium Sulphide (liver of sulphur)	3 ounces
Water	10 gallons

This solution is valuable for the gooseberry and other powdery mildews, for which it seems even more effectual than Bordeaux mixture, although its effects are less lasting. It does not discolor the fruit and is quite harmless.

KEROSENE EMULSION.

This is a well-known remedy for use upon soft-bodied or scale insects that suck the sap. It is made from kerosene, water and soap, either hard or soft, or whale oil.

To one quart of water add one pint of soft or two ounces of hard soap and heat until the soap is dissolved. Add one pint of kerosene and agitate freely for from three to five minutes, or until it forms a cream-like emulsion, from which the oil does not separate upon standing. This is a stock solution and can be kept for any length of time. Before using, it should be diluted according to the condition of the trees and kinds of insects. For scale insects it is desirable to spray while the trees are dormant, after diluting this stock solution so that there will be one part of kerosene to three of water, but if it is applied for the same class of insects while the trees are in leaf, the amount of water should be at least seven or eight times as great as of the kerosene in the stock solution. At this strength it will be fatal to all soft-bodied insects and to many of the scales, while for many of the insects with soft bodies it will be found sufficiently powerful if fifteen parts of water are used to one of the kerosene.

When making the emulsion with whale oil soap, the amount of the soap will vary with the amount of water it contains. If in a semi-liquid condition, one pint will answer for a pint of the oil, while four ounces will be sufficient if it is in a solid form.

In making the emulsion care should be taken to keep the kerosene away from the fire, and a force pump should be used rather than to rely upon a spoon or paddle.

SOLUBLE OILS.

The various "soluble" oils that are being sold for the control of the San Jose scale have been carefully tested, but while they kill a very large per cent of this insect, owing to the rapidity with which it breeds, the trees will be more thickly infested at the end of the season than before they were sprayed. Aside from being ineffectual against the scale at the strengths recommended, these remedies are quite expensive and have no fungicidal value. By using them three or four times as strong as recommended by the manufacturers their efficiency will be increased, but this will make their cost several times that of lime and sulphur, and, unless very carefully used, injury may be done to the trees.

PARIS GREEN.

Paris Green	1 pound
Water	100 to 200 gallons

For the destruction of insects that eat the foliage or fruit, Paris green is a valuable remedy. It can be used in water in the above proporations, the stronger mixture being used for potatoes, while for fruits it is seldom advisable to use more than 1 pound in 200 gallons of water. unless in connection with lime water or Bordeaux mixture. It is always advisable to first form a paste with a small amount of water when preparing it for spraying. For low plants Paris green may be used in a powder form either alone or with one hundred times its weight of plaster. London purple is sometimes used in place of Paris green. but it is more apt to injure the foliage. Green arsenoid and arsenate of lead are valuable substitutes for Paris green.

WHITE ARSENIC.

As Paris green is quite expensive and is sometimes adulterated, white arsenic is frequently used in its place. Its cost is about one-third that of Paris green, and, as it is nearly twice as effective, the expense is only one-sixth as much as when Paris green is used. To prepare arsenic for use the following treatment is necessary: In two gallons of water place two pounds of freshly slaked lime and one pound of arsenic; after boiling thirty to forty minutes the arsenic will have dissolved and united with the lime, so as to form an insoluble compound. When desired for use the arsenic should be diluted, and one pound prepared as above will suffice for two to three hundred gallons when used upon fruit trees, or one hundred fifty gallons for spraying potatoes. That there may be no injury to the foliage, it is desirable to use the arsenic thus prepared either with Bordeaux mixture or lime water. When lime water is used, one pound of lime will be sufficient for twenty gallons of water. Although the spraying calendar does not refer to arsenic, it can be substituted for Paris green if desired.

LIME AND SULPHUR MIXTURE.

(For the San Jose Scale.)

Lime (unslaked)	15 to 25 pounds
Flour of Sulphur	15 pounds
Water	15 gallons

Boil one hour and diluted to fifty gallons.

The best remedy that has been found for the San Jose scale is sulphur and lime prepared after the above formula. Where one has only a few acres of orchard to spray a jacketed iron kettle will answer for cooking the spray mixture. Place ten or fifteen gallons of water in a kettle and as soon as it boils add the lime. Fifteen pounds will answer if unslaked but the amount should be increased if much of it has be-

come air-slaked. The maximum amount given above will not be excessive and as it will serve to whiten the trees and show the thoroughness of the spraying, it is often advisable. Make a paste of the sulphur and turn it into the kettle or sift it in slowly. The sulphur and lime should be thoroughly stirred while the lime is slaking, and occasionally until the boiling has been completed. By continuing the boiling for fifty to sixty minutes the liquid will have changed to a reddish amber color, when it will be ready for use. In order to have all the sulphur dissolved, boiling for one hour will be safer than for a shorter period. Cold water can be used for diluting if it is not convenient to use warm water. While the mixture need not be boiling hot, it should be at least warm enough to prevent crystalizing of the sulphur.

If a large quantity is required, steam can be used for boiling the mixture. This can be done either in barrels or in a tank holding 100 to 150 gallons.

The best results will be obtained when the spraying is done in the spring just before the buds open. Fairly good results can be secured in the fall, but winter applications will be found less effectual.

In addition to being the best remedy for the San Jose scale and other insects, the sulphur and lime solution is an excellent fungicide. When this has been used there will be no occasion for spraying with Bordeaux mixture previous to the setting of the fruit. It will also destroy the eggs of any insects upon the trees as well as any that are present in the other stages of development.

Con-Sol, Horicum, Salimene, and other preparations of lime and sulphur that are upon the market have not been found satisfactory.

HELLEBORE.

Fresh White Hellebore....................	1 ounce
Water	5 gallons

For insects that chew, and especially for the currant and cabbage worms.

PYRETHRUM OF BUHACH.

Pure Fresh Pyrethrum	1 ounce
Water	5 gallons

Valuable against both chewing and sucking insects, especially upon maturing fruits or vegetables, and upon flowering plants. It can also be applied in a powder form with a bellows.

CAUTIONS.

The copper solution should be made in wood, glass or earthen vessels, and should not be prepared in iron or tin.

Care should be taken against spraying plants of any kind with lime or poisonous mixtures within four or five weeks of the time they are to be used as food.

Study carefully the nature of the insect or disease and select the remedy that is most likely to destroy it without injuring the plants.

Do not spray while the trees are in blossom, as the bees will be destroyed; they are necessary to fertilize the flowers.

Pumps for the application of insecticides and fungicides should be sufficiently powerful to cover the trees or plants with a fine mist, and where copper compounds are to be used, the working parts should be of brass, and if all portions that are to come in contact with the spraying mixture are of brass, the durability of the pump will be greatly increased, except when the sulphur, lime and salt wash is used. For this an iron pump is better. It should have metal valves and should be rinsed out each day when through spraying.

ORCHARD SPRAYING.

BY L. R. TAFT.

Special Bulletin No. 37.

SUMMARY.

I. San Jose scale has appeared in Michigan orchards, especially in the eastern and western counties.

II. It attacks all kinds of fruit trees, although the sour cherry is little injured, and unless measures are taken to control it, will destroy them.

III. The sulphur and lime mixture is the most effectual remedy. It is also the cheapest and is worth all it costs for the prevention of fungous diseases.

IV. A good formula is fifteen pounds of sulphur, fifteen pounds of lime, and twenty gallons of water. Boil one hour and dilute to fifty gallons.

V. The so-called soluble oil remedies have not been found effectual even when used at double strength. They have no value as fungicides and unless carefully used are sometimes injurious to trees.

VI. Potato blight and rot often cause severe losses during wet seasons. Both can be prevented by using the Bordeaux mixture.

VII. The black rot and mildew, in seasons when the weather is favorable for their development, often do much harm to grapes. Both of these diseases can also be held in check by the use of Bordeaux mixture.

VIII. Orchards of all kinds should be sprayed with Bordeaux mixture and an arsenite. The trees should be sprayed just before the blossoms open and all except the peach will be benefited by from one to five other applications made at intervals of two weeks, beginning as soon as the fruit is set.

THE SAN JOSE SCALE AND ITS TREATMENT.

Of the insects injurious to fruit trees none are likely to do more harm than the one to which the name of San Jose scale has been given. It was first found in Michigan some ten years ago, although it was probably brought in upon nursery stock several years before its discovery. At first it was claimed that it could not live in Michigan, but it has already spread into the sixth tier of counties from the Indiana line. It must not be understood that it is in all of the southern counties, as it has not been found in more than one-half of the counties in the six southern tiers, and in most of those where it has been found it is known to occur in only a few orchards. There are eight or ten counties in which it has become quite generally distributed in some of the townships, but even there it is probable that it does not occur upon one-half of the trees. It has spread most rapidly in the leading fruit-growing districts and in the cities and villages, because the conditions there favor its introduction and spread. In the counties where the land is largely devoted to farm crops, comparatively few trees are purchased, and as the orchards are widely scattered the scale cannot spread rapidly.

The climatic and other conditions were evidently favorable for the spread of the scale during the last season, as hundreds of orchards in which it was not possible to find any scale last spring are now quite badly infested. Unless the owners of these and other infested orchards take prompt and effective measures to rid their trees of the pest, it will be only a question of the time that must elapse before the trees will be killed by the scale. It is not uncommon to find a young peach tree practically ruined in one or two years, while not more than four or five years will elapse before pear, plum and small apple trees will be killed by the scale.

ITS APPEARANCE ON THE FRUIT.

In order to protect the orchards one should be informed regarding the appearance of the scale, so that its presence may be detected before it has done serious harm to the trees. During the late summer it is an easy matter to determine, if it is in a bearing orchard, as it can be readily noted upon the fruit, especially those of a yellow or green color. Wherever the San Jose scale has settled upon a fruit there will be a round red spot about one-eighth inch in diameter, in the center of which there will be a small black dot, which is the scale itself. They may be anywhere upon the fruit but are most plentiful at the blossom end and the basin is often fairly encrusted with them. It must not be thought that every red spot containing a black dot is caused by the San Jose scale, as the Greening and other yellow and green apples often have similar spots and dots that it is difficult to distinguish from those due to the San Jose scale even with a hand lens. A very simple test, however, is to endeavor to remove the black dot with the finger nail or

a pin point. If it is the San Jose scale it can be easily lifted or rubbed off, and the skin beneath will be smooth and unbroken and of a greenish color, while if it is not the scale it cannot be removed without tearing the skin, which will be rough and broken. The spots referred to are generally the result of slight injuries, and the dots are a sort of corky growth developed to repair the injury. Other scales also cause a similar discoloration of apples. The most common is the scurfy scale, but this can be readily distinguished from the San Jose, as it is grayish-white, generally somewhat heart-shaped and several times as large as the San Jose scale.

During the latter part of the summer the San Jose scale propagates very rapidly and even though there were only a few upon the trees in the spring they may be entirely covered by the close of the season. Examination of an infested tree during the winter and spring will reveal the presence of small black dots, often so thick as to overlap one another. They will be circular in form and of about the size of an ordinary period (.). If examined with a hand lens a circular groove will be noted around the center which will have something of the appearance of a nipple. Other scales that slightly resemble the San Jose have a point, usually at one side of the center which is of an orange or yellow color. These scales are usually larger than the San Jose, and are more or less oval in form and grayish or brown in color.

HOW IT LOOKS ON THE BRANCHES.

If the shell-like covering of the San Jose scale is lifted off, the living portion of the scale will be found beneath. This in a general way resembles a very small larva of a potato beetle, except that it is yellow in color and is filled with a yellow, oily fluid, to such an extent that if the thumb nail is rubbed over where there are a considerable number of the scales a substance that resembles melted butter will exude in noticeable quantities. This test is sometimes used to determine the presence of the scale and the relative number that have been killed, but for the latter purpose it is not very reliable.

In order that one may be positive regarding the presence of the San Jose scale a good pocket lens is desirable. Something that will answer the purpose can generally be found at an optician's for fifty cents. Having in mind that the scale is round, flattened, black, and with a small nipple at the center, one is prepared to examine the trees and learn if they are infested. It should also be noted that when the scales die the shells take on a gray color so that a tree that has been infested for a number of years will look as if coal ashes had been thrown over it.

From the fact that the scale prefers the soft growth and that the young branches are easiest injured by their punctures, the tops of the trees die first. The leaves turn yellow and drop off and when the trees are badly infested they will generally die during the winter. As the trunks and larger branches are still full of life, water-sprouts are often sent up from the main crotches of young trees, so that they have a luxuriant appearance although the tops of the trees are dead. This makes it possible to save trees that have been quite badly injured by the scale, by cutting off the injured branches and forming a new head from the water-sprouts that will soon form. It will be an easy matter to spray

the trees after they have been pruned and with good care they will perhaps be in even better condition than before they were attacked. One should not expect the best results from this treatment upon old trees, or after they have been seriously injured.

THE PROPAGATION OF THE SCALE.

Unlike most other scale insects the San Jose scale brings forth its young alive. About the middle of June, in this latitude, the young scales will begin to appear from beneath the covering of the old females. A single scale will often develop four or five hundred. At first, the young are so small that they can barely be distinguished by the unaided eye. They are yellow, oval in form and can move about to some extent by means of six poorly developed legs. For a few hours, or perhaps days in some cases, they crawl along the branches until they find what seems a suitable place, when they insert their long thread-like beak into the bark and begin their transformation, after which time they do not move from this place. In a short time the young scale takes on a circular form and begins to secrete a shell. At first it has a creamlike color but it soon turns dark brown or black.

In seven or eight weeks, or about the middle of August, the second brood will appear and develop exactly the same as the first, and a third and perhaps a fourth brood will appear later in the season. As the different females will not breed at exactly the same periods it will be possible to find crawling larvae upon the trees at almost any time from the middle of June until the weather becomes quite cold. The partially developed insects are generally killed by the winter, but, if one per cent winter over, the trees will by the middle of June be as badly infested as they were in the fall. It can be readily seen that if each female scale develops 400 young, one-half of which are females and that all of these breed and if this is continued until four broods have been produced, the progeny from a single female scale in one season will amount to more than three billions. Even though but two females from each brood live and breed the increase will in a single season be a hundred fold.

HOW IT IS DISTRIBUTED.

As the female scales at no time have wings, it is a question as to how they spread from tree to tree and from orchard to orchard, as it is known that their legs could at most carry them but a few feet and over a comparatively smooth surface. It is supposed that, while crawling, the larvae might get upon the legs of other insects and even of birds and thus spread over large areas. It is also quite sure that the wind serves to spread them to considerable distances and in large numbers.

For a number of years after its introduction into the eastern states, where it first appeared in some of the large nurseries, it was distributed broadcast upon nursery stock. The laws of nearly all of the states now require the inspecting of nursery stock before it is dug, and if any trees are found to be infested they are destroyed and all other trees that are subject to attack that have grown within a half mile must be fumigated with hydrocyanic acid gas at a strength that has been found fatal to the scale and yet which will not injure the trees.

PRUNING.

In case an orchard has become infested with scale, it will greatly simplify the work of spraying if the trees are first thoroughly pruned. All surplus branches should be removed and the ends of the leading shoots should be cut back. In case the trees are badly infested so that serious injury has been done to the branches, it will be well to cut them back to where the wood is reasonably sound. In the case of peach trees, it will always be well to head back rather more than with other trees and thus not only form a new head but to keep it nearer the ground so as to facilitate spraying, thinning and gathering the fruit. By pruning the trees in this way, it will not only make it possible to lessen the cost of labor and material for spraying but it will greatly assist in securing thorough and effectual work.

SPRAYING FOR THE SCALE.

When an orchard has become infested, the only way of controlling the ravages of the scale is to spray the trees with some substance that will destroy it. The question is often asked as to whether it will pay to spray all of the trees in an orchard in case it is known that the scale has been found upon only a few of them. The treatment would vary to some extent with the kind of tree, as certain varieties are more injured than others. In the case of peach trees which are quickly injured and upon which the scale spreads very rapidly, it will always be well to spray the trees in an orchard that are in the vicinity of those known to be infested. The same rule will hold true with most varieties of plums and pears and in young apple orchards containing Baldwin and Duchess and other varieties that are especially subject to attack. The idea of this treatment is to prevent the injury to the trees that often occurs if the scale is allowed, for a single season, to develop upon the trees. In considering the benefit of the spraying, one should take into account the value of the treatment in controlling fungous diseases. If sulphur and lime is used, and this at the present time seems to be the only remedy that is in any way effectual, the value of the application as a fungicide will be worth all that it costs. This is one of the best remedies known for the control of the leaf-curl of the peach as well as for the destruction of the spores of apple-scab, brown-rot, leaf-blight and other fungous diseases. It has been known for several years that it is well worth while to spray fruit trees, of all kinds, with Bordeaux mixture before growth starts in the spring. An application of sulphur and lime will not only serve for the destruction of the San Jose scale, but it will render it unnecessary to spray with Bordeaux mixture before the buds open.

When sulphur and lime has been used upon fruit trees, it tends to remove the rough bark, moss and lichens, and the bark takes on a fresh, healthy appearance. In fact, trees that have been for a single season infested with scale, and then sprayed with sulphur and lime, present a much healthier appearance than other trees of the same varieties and growing under similar conditions that have neither been infested nor sprayed.

REMEDIES FOR THE SCALE.

For the last ten years experiments with various remedies for the scale have been tested. Among the first was whale-oil soap, and when a potash soap was used at the rate of two pounds in a gallon of water it made a fairly effectual remedy, but as it cost seven or eight cents per gallon for the diluted mixture, it was rather expensive treatment. Kerosene and crude petroleum both in a pure state and in soap and mechanical emulsions were next recommended. Especially upon peach trees, the use of kerosene and petroleum often resulted disastrously from the fact that it was very difficult to secure uniformity in the emulsions. To destroy the scale it is desirable to have 20 to 25 per cent of oil in the emulsion, and if the oil separates there is always danger on the one hand of injuring the trees and on the other of not having it strong enough to kill the scale. It sometimes happens that the presence of scale in an orchard is not noticed until after growth has started and if sufficiently numerous to do much harm to the trees, it will be well to spray the trees when the insects are in the larval form, as at that time they can be destroyed with remedies that can be applied without injuring the trees. A kerosene emulsion made with 10 per cent of oil for apple trees and 8 per cent for all others, used about the first of July and then if necessary, at the last of August, will do much to keep down the numbers and thus lessen the injury to the trees until the time comes when the more powerful applications can be used.

THE SULPHUR AND LIME MIXTURE.

Some years ago it was ascertained by California fruit growers that a mixture containing sulphur, lime and salt, which they were using as a sheep dip, was a very effectual remedy against the San Jose scale. It has now been thoroughly tested in the eastern states and is generally regarded as the cheapest, safest and in every way the best remedy. Many persons are omitting the salt, but it seems to have some value in holding the mixture upon the trees in case heavy rains occur. In Oregon the salt was replaced by four or five pounds of copper sulphate for fifty gallons of the wash, but this seems to add nothing to its value even as a fungicide and it may well be omitted.

In order to secure results from this mixture, the sulphur must be brought into chemical combination with the lime so that it will dissolve in the water. This can only be secured by the application of heat and in the preparation of the sulphur and lime mixture, it is always necessary to boil it for forty-five to sixty minutes either with a fire or by the use of steam.

When only a small quantity is to be prepared an iron kettle can be used for boiling the mixture. If it can be jacketed, or set in brick work, it will result in economy of fuel and will also facilitate the boiling. There are also various stock-food cookers that answer well for boiling the sulphur and lime mixture. When steam is used, it can be furnished from a traction engine or by the use of a small, steam boiler. There are

a number of steam food-cookers that answer very well. A boiler with a capacity of six or eight horse-power will cook about one hundred gallons at a time.

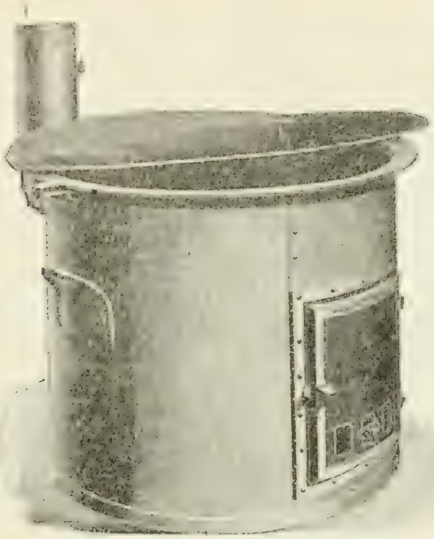


FIG. 1. Kettle for Cooking Sulphur and Lime.

THE COOKING PLANT.

A large number of orchardists who have considerable areas that require spraying for the scale have put up cooking plants that are in a way models of their kind. Among the principal requirements are, an abundant supply of water so arranged that it can be drawn directly into the cooking tank, and an elevated platform upon which the cooking tank can be located so that the prepared mixture can be drawn at once into the spraying tank and thus do away with the necessity of dipping it. For use with steam a small shed or other building should be provided as a protection for the boiler. The platform should be elevated about six feet above the level of the ground where the spraying wagon will stand. Upon this three or four barrels, or a tank with a capacity of one hundred and fifty gallons should be placed. In order that the steam may prove most effectual, there should be a pipe running along either side of the tank with a row of one-eighth inch holes about six inches apart. These should be so arranged as to direct the jets of steam across the tank. When barrels are used, a one and one-fourth inch steam pipe should lead from the boiler over the tops of the barrels and from this a three-quarter inch pipe should drop into each. At the lower end of these pipes, which should be just above the bottom of the barrel, there should be a semi-circular coil which should be pierced on the upper side with six or eight one-eighth inch holes.

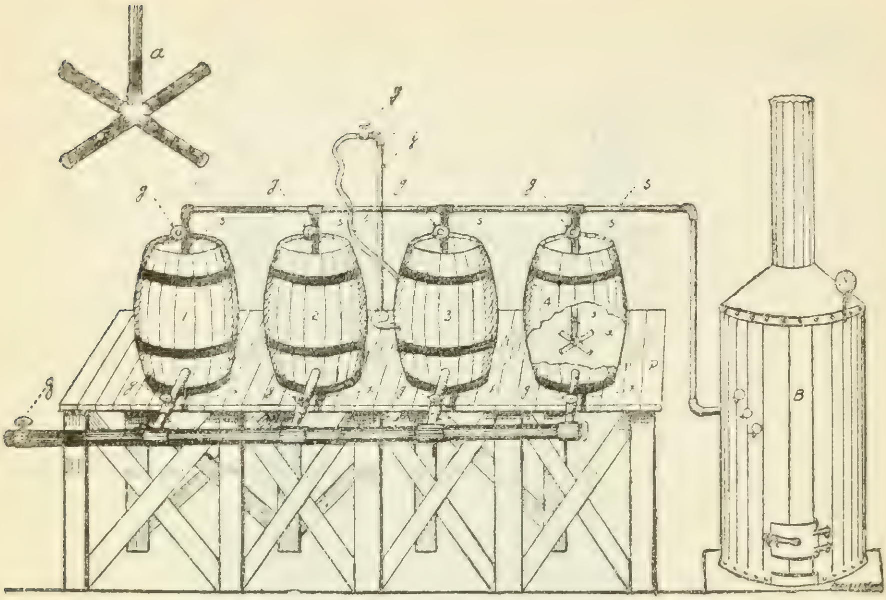


FIG. 2. Steam Cooking Outfit.

(From Bulletin 17, Georgia State Board of Entomology.)

B, boiler; *P*, platform; *1*, *2*, *3*, *4*, barrels; *s*, steam pipe; *a*, lower end of steam pipe, with perforated cross-arms; *g*, valves, *j*, water supply pipe; *x*, draw-off pipe.

PREPARATION OF THE MIXTURE.

Various formulas for the sulphur and lime mixture have been recommended, but most of them call for fifteen pounds of sulphur and the same or a little larger amount of lime. While the use of fifteen pounds of lime will be sufficient to form a chemical compound with the sulphur, it is always well to use a somewhat larger amount as the undissolved lime shows upon the trees and thus makes it easier to be sure that a thorough job has been done. On this account, and because there is always more or less lime that is air-slaked, we have recommended twenty-five pounds of lime and fifteen pounds of sulphur for making fifty gallons of the mixture. At the time the mixture is prepared, however, it is not necessary to use more than one-half the amount of water that there will be in the final mixture. If fifty gallons are needed we would recommend the following procedure: Place twenty-five pounds of lime in a barrel or kettle and add hot water until slaking has commenced. When the slaking is well under way, enough water to cover the lime should be supplied and the sulphur should then be added. It will be well to first make a thick paste of the sulphur by the addition of a small quantity of water. The sulphur and lime should then be thoroughly mixed, using a hoe or a shovel, and as soon as the lime has slaked the boiling should begin, after adding water enough to make twenty to twenty-five gallons. While it will generally suffice if the boiling is kept up for forty-five minutes, figuring from the time the mass has been brought to the boiling point, there will be no harm done if it is continued for at least one hour, as if any of the sulphur has not combined with the lime it will

be practically wasted. When ready for use the remainder of the water should be added. It is not necessary to have the mixture boiling hot at the time of application but it will work best if it is applied while slightly warm. The addition of twenty-five to thirty gallons of cold water to a similar amount of the boiling mixture will not make it too cool for application.

The use of stone lime is always to be preferred to that of hydrated lime, as a considerably larger amount of the latter would be required and there would be no heat secured from its slaking, which is very helpful in hastening the boiling of the mixture when stone lime is used. While heat is necessary for securing the chemical union of the sulphur and lime the source of the heat makes little difference, and, when conveniences are not at hand for boiling, fairly good though less effectual results can be secured from utilizing the heat from the slaking of the lime for the boiling. For this purpose take about fifteen pounds of lime and fifteen of sulphur and after having slaked the lime and added the sulphur as directed above, cover the barrel so as to retain the heat. After one hour, add ten pounds more of lime and by the time the mass has cooled a very large proportion of the sulphur will have combined with the lime. Another method for the chemical cooking of the sulphur and lime is to substitute five pounds of caustic soda for the last ten pounds of lime.

PATENT SCALE REMEDIES.

A large number of ready prepared spraying mixtures have been placed upon the market but, although all of them have been brought out with testimonials that upon their face would indicate that they are entirely effectual as remedies, the results as we have tested them have in no case been satisfactory. While they kill a very large per cent of the scales, the insects reproduce so rapidly that even though less than one per cent remain alive upon the trees, they will be more badly infested in the fall than before the trees were sprayed in the spring. Unless much better results can be secured than this a remedy cannot be regarded as effectual. Quite a number of the proprietary remedies are composed of sulphur and lime, and it is claimed for them that they are even more effectual than the home-prepared mixture. When used at the strength recommended they are considerably more expensive and as analysis shows that the amount of sulphur contained in the mixture will be considerably less than is called for by the regular formula, it is not strange that they prove less effectual.

Of these mixtures, Con-Sol was most generally used in Michigan. After trying it for one year and finding it ineffectual, fruit growers were cautioned against its use. The manufacturers then claimed that they had changed the formula and that it would be found all that could be desired. A second trial, however, failed to substantiate their claims and its manufacture was then given up. The various other mixtures of a similar nature that were brought out have given no better results. Recently one or two remedies in which all of the sulphur and lime is in solution have been placed upon the market. These also are claimed to be entirely effectual, but in view of the experience with the other prepared sulphur and lime remedies their use even in an experimental way cannot be recommended until something more is known about them.

Several mixtures in which the active agent is a mineral oil, treated in such a way as to readily form an emulsion when water is added, have recently been placed upon the market. These have been thoroughly tested for one to three years upon all kinds of trees and the results which have been reported each year have been far from satisfactory.

TESTS OF REMEDIES IN 1906.

During the past year all of the soluble oils that were then upon the market were tested in a peach orchard in comparison with sulphur and lime of the standard strength. The so-called K-L (kerosene and lime) mixture was also used both with hydrated and with air-slaked lime. All of the soluble oil mixtures were used at the strength recommended by the manufacturers (one part of the soluble oil to twenty parts of water), and also at twice that strength.

Among the remedies tested were the following:

The Target Brand Scale Destroyer, which is white and of a thick, cream-like consistency. The form sent out last spring would only work well when diluted with soft water, and gave considerable trouble to many persons who had only hard water at hand. The manufacturers claim to have overcome the difficulty. This like all of the other soluble oils gave no trouble when used with soft water, and except to the hose was not especially destructive to the spraying apparatus. It is said to contain about twenty per cent of mineral oil, from which the lighter portions have been distilled, so that when used at the rate of one to twenty parts of water, the emulsion would contain about four per cent of oil;

Scalecide, which is claimed to be an emulsion of crude petroleum, and its appearance bears out the claim, was in every way satisfactory so far as its preparation and application were concerned;

Kil-o-scale, another soluble oil, which greatly resembles Scalecide, although it appears to be somewhat thicker; and

Scalespray, which has a milk-like appearance and the odor of turpentine, and was manufactured and sold by a Michigan firm, gave if anything, less trouble than the other mixtures to prepare and apply.

Two K-L mixtures were also used. One was prepared with air-slaked lime and the other with dry-slaked lime, although ordinary hydrated lime as sold could have been used. The dry-slaked lime was prepared by taking stone lime and slaking it, using only as much water as would be taken up and leave at the close a dry powder. The preparation of the two forms was identical. After sifting, forty pounds of the lime was placed in a barrel and ten gallons of kerosene was added. It was then stirred to form a homogeneous mass. Forty gallons of water was then added and it was ready for use. The stirring should be continued all the time the oil is being added, and also while the water is being turned in to dilute it.

COMPARATIVE COST OF SPRAYING MIXTURES.

The following tables show the cost of the various mixtures as compared with sulphur and lime, considering not only the original cost of the materials, but the labor of preparing the K-L and the sulphur and lime mixtures. It should be said that the cost of sulphur varies in

different parts of the state, but it was sold by druggists in many places last year at $2.50 to $2.75 per 100 lbs. When purchased in bags in carload lots it can be laid down in most points in Michigan at $2.15 per 100 lbs. Battelle and Renwick, 163 Front street, New York, offer it in bags in 100-pound lots, f. o. b. New York, at $2.30 per 100 lbs. and at $1.90 in carload lots. The freight to Michigan points on small lots would be 45 to 50 cents per 100 lbs. When shipped in carload lots the freight would be not far from 25 cents per 100 lbs. When put up in barrels the price would be about ten cents more per 100 lbs., but as this would be fully equaled by the reduction in freight upon lots less than 100 lbs., and the sulphur will be in better condition, it will generally be advisable to order the sulphur in barrels if to be shipped in small lots by freight. As will be observed, the cost is estimated at the usual price in barrel lots for soluble oils and the price put down for sulphur and lime is about what is charged for these materials when purchased in quantities of one hundred to five hundred pounds.

Material.	Amount.	Cost per unit.	Cost of Materials.	Cost of Preparation.	Total cost per 50 gals.
Soluble oils	2½ gals.	50c.	$1.25	—	$1.25
K-L Mixtures—					
Kerosene	10 gals.	10c.	1.00	8c.	1.28
Lime	40 lbs.	½c.	.20		
Sulphur–Lime Mixtures—					
Sulphur	15 lbs.	3c.	.45	15c.	.72½
Lime	25 lbs.	½c.	.12½		

From the above it will be seen that the soluble oil sprays figured at the lowest prices at which they are furnished, cost 2½ cents per gallon, while the K-L mixture cost practically the same. The sulphur and lime mixture, after allowing liberally for the cost of its preparation and reckoning the materials at prices somewhat higher than sold for at retail in sections where there is a large demand for them, cost slightly less than 1½ cents per gallon.

MAKING THE TEST.

The comparative test of the different mixtures was made in a peach orchard near South Haven in which the trees were about eight years old, under the supervision of Mr. F. A. Wilken, Superintendent of the South Haven sub-station. The San Jose scale had become very evenly distributed through the orchard, but the trees had not been very seriously injured. The soluble oils were prepared at the strength recommended by the manufacturers, that is, one gallon of oil was used in twenty gallons of water, and in order that the results of increasing the strength of the application might be determined, duplicate experiments were carried on, using one gallon of oil in ten gallons of water. The K-L and sulphur and lime mixtures were at the usual strength as noted in the above table.

One of the claims made for the soluble oils is that they spread upon the trees so that a somewhat smaller amount than is required of the sulphur and lime will suffice. In this experiment twenty-five gallons of each material was prepared and instructions were given to spray the

trees thoroughly and note how many could be covered. It was found possible to spray seven trees each with Target Brand and Kil-o-Scale; eight were sprayed with the Scalecide and Scalespray, but some of these were slightly smaller than those in the plots sprayed with the first named mixtures; eight trees were sprayed with kerosene and air-slaked lime mixture, while nine trees were covered with the twenty-five gallons of sulphur and lime. This does not necessarily mean that the sulphur and lime spreads more, or will go farther than the other mixtures, but the men who were doing the work felt that they could cover more trees with it owing to the fact that it showed plainly upon the branches and they were thus able to determine the portions that needed spraying, while in order to make sure of it with the other materials, they found it necessary to use a somewhat larger quantity. At any rate, the above amounts were used, and so far as the results were concerned, the increased amounts of soluble oils used should have been in their favor.

THE EFFECT OF THE APPLICATIONS.

The trees were examined a number of times during the spring and summer and the results noted. By the first of May it was evident that a large proportion of the scale had been killed. The number of live scale found was so small and they were distributed so irregularly over the trees that no attempt was made to form an estimate of the per cent that had survived the different sprayings.

In July, after practically all of the first brood had appeared, the trees were looked over very carefully and an endeavor was made to determine the results of the spraying. The row of trees sprayed with sulphur and lime was practically free from young scales, but here and there one could be found crawling upon the branches. The good effects of the spraying, upon the removal of the old scales and the appearance of the bark, were very noticeable. There were practically no scales upon the branches, and even the older limbs of the trees had taken on a bright, healthy color. There was comparatively little difference in the number of the young scales upon the trees sprayed with the various soluble oils and the K-L mixtures, although Scalespray seemed to show the least benefit, while Target Brand appeared to give better results then either Scalecide or Kil-o-Scale. Unlike the trees sprayed with sulphur and lime, the old scales were still upon the branches, giving them a grayish appearance. No such marked benefit upon the appearance of the bark was noticed as in the case of the trees sprayed with sulphur and lime.

Several examinations were made during the summer which showed that the scale continued breeding rapidly upon the trees sprayed with the various oil mixtures, but where sulphur and lime was used very little increase in the number of scales could be detected although the trees were surrounded with other trees sprayed with the oil mixtures, which were rapidly becoming encrusted with the scale, and it would hardly be possible for three or four months to elapse without large numbers of the scale being carried by birds, insects and, probably more than in any other way, by the wind from these trees to those that had been treated with sulphur and lime.

At the end of the season, branches that represented the average condition were cut from each of the trees and the following table shows the condition of each plot, the figures given representing the percentage of

infestation of the different plots as compared with their condition in the spring before they were sprayed. As will be seen, the effect upon the sulphur and lime sprayed trees had been very marked. The number of scales upon the branches in the fall was only ten per cent as large as in the previous spring, while in the case of Scalespray the number had increased five-fold, with a somewhat smaller number upon the trees sprayed with the other oil mixtures. On the 10th of October the breeding of the scale was checked by a severe freeze, which also destroyed all of the crawling larvae and young sets, but in spite of this many of the branches had become very badly encrusted, so that had the last brood developed the trees sprayed with the oil mixtures would have been practically covered with the scale.

Material Used.	No. of Scale, Dec 1, 1906. (As compared with No. April 1.)	Relative Infestation.
Kil-o-Scale (1-20)	4	40
Target Brand (1-20)	3	30
Scalespray (1-20)	5	50
Scalecide (1-20)	3½	35
Kil-o-Scale (1-10)	3½	35
Target Brand (1-10)	2½	25
Scalespray (1-10)	4	40
Scalecide (1-10)	3	30
Sulphur and lime mixture	.10	1
Kerosene and lime (air-slaked)	2	20
Kerosene and lime (dry-slaked)	2	20

The above showing for sulphur and lime could only be reached by taking the utmost care to secure thoroughness in making the application. In the case of apple trees it would not be possible to secure such a result, as the size of old trees, together with the loose bark upon the branches, would interfere with the results while the fine, hairy growth with which the bark upon the shoots of young trees is covered would prevent the spray from reaching and destroying the scales.

The work of spraying will be made much easier and the expense will be greatly reduced if trees infested with the San Jose scale are thoroughly pruned before they are sprayed. The amount of cutting back will depend largely upon the size and kind of trees and also upon the extent to which they are infested. If the trees have not been seriously injured by the scale, the pruning need be only such as is necessary to bring them into a compact form for spraying. It will be well then to thin out the tops of the trees, as much as can be done without injuring their form and to head back the ends of the leading shoots as these are not only the ones that are the most likely to escape in spraying, but, where pains is taken to make sure that they are covered, the labor and material will be several times greater than will be required to spray similar areas in the interior of the tree.

The injury from the San Jose scale is especially noticeable upon branches that are one inch or less in diameter. To such an extent is this true that trees often have all of their branches killed while the trunk and main limbs have been little, if any injured. Particularly with peach trees, and young trees of all kinds, it will be possible to head back the branches, even when all of the smaller shoots have been killed, and

form a new head. When pruned in this way the amount of surface that will require spraying will be quite small and very easily reached.

SPRAYING MACHINERY.

The spraying apparatus should be adapted to the amount of spraying required. While a comparatively small outfit would answer to spray an orchard of young trees, the saving in time that could be secured if many trees are to be sprayed, would more than balance the extra cost of the spraying outfit, if a pump of good size is procured.

For a few trees in the garden some of the so-called bucket spray

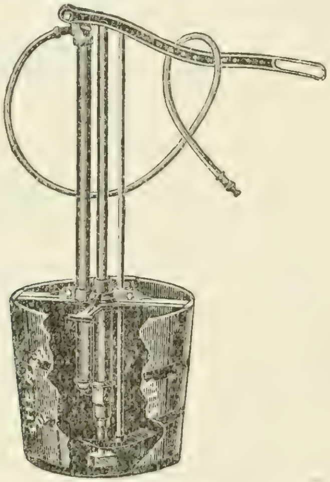


FIG. 3. Hardie Bucket Pump.

pumps could be used. Some of these have sufficient power to reach the top of a tree of average size and they can be readily carried from tree to tree by hand. Where many trees are to be sprayed it will be better

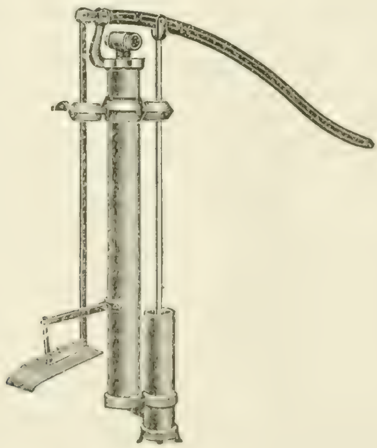


FIG. 4. Barsc Eliperel Pump.

to use a barrel pump which can be placed either on a stone boat or in a wagon or cart and drawn through the orchard by a horse. These pumps should be easy working and so constructed as to be durable and not likely to get out of order. Where to be used also for Bordeaux mixture the working parts at least should all be of brass but if to be used for sulphur and lime, some of the combination pumps will be even more durable and considerably cheaper. These pumps should have not only spraying rods from eight to twelve feet in length, according to the size of the trees, but the connecting lines of hose should be of a length of

Fig. 5. Wallace Traction Spraying outfit.

fifteen to twenty-five feet so that those handling the spraying rods can stand some distance away from each other and from the pump, thus lessening the amount of spray that will reach the other workmen and the team. Care should also be taken that there is no leak in the hose and that all joints are tight. To prevent the liquid running down the spray rod to the hands a gasket of rubber, or leather, can be placed upon the spray rods which will cause it to run off to the ground. With a little care in spraying, the amount that will get upon the persons of the workmen can be reduced to a minimum. It will also be well, however, for them to wear rain coats and some kind of gloves or mittens that will keep the spray mixture from the hands. In some sections heavy canvas mittens, or gloves, that have been soaked in oil are used. Blankets for the horses will also be necessary.

When large areas are to be sprayed the use of power outfits will not only hasten the work but will prove more economical and effectual, particularly for small or medium-sized trees. Traction outfits such as that made by the Wallace Machinery Co., Champaign, Illinois, answer very well, but for larger orchards, especially for trees of the largest size, the gasoline spraying outfits have some advantages. These are manufactured and sold by the Olds Gas Power Co., Lansing, Mich., The New Way Motor Co., Lansing, Mich., and the Wallace Machinery Co., Champaign, Ill., which makes two different outfits, in one of which the engine is attached to the same pump as is used in their traction outfit and the other where the engine is used to operate an ordinary spray pump. The Hardie Co., Hudson, Mich., Spramotor Co., Buffalo, N. Y., the Deming Co., Salem, Ohio, and the Goulds Mfg. Co., Seneca Falls, N. Y., are among the other firms that make spraying outfits operated by means of gasoline engines, as well as barrel spray pumps. Morrill & Morley, Benton Harbor, Mich., make the Eclipse Barrel Outfit.

Among the other forms of spraying outfits is one in which the power comes from carbonic acid gas under a high pressure which is manufactured by the Niagara Gas Sprayer Co., Middleport, N. Y. The liquid is placed in a large steel tank to which is connected a drum of gas and all that is necessary to obtain any desired pressure is to open the stop cock and allow the gas to rush into the spraying tank thus forcing the liquid out. At the present price of gas the power for operating these machines will cost from one-fourth to one-third of a cent per gallon. As there is no machinery to get out of order and as their operation is very simple, this form of outfit has considerable merit.

Whatever form of spraying outfit is used, its durability can be greatly increased and it will be likely to cause very much less trouble in spraying if it is thoroughly washed out each day after being used.

THE BLIGHT AND ROT OF POTATOES.

For a number of years the potato crop in the eastern states has been greatly reduced by what is commonly known as blight and rot. Little harm, however, has been done in Michigan except during the seasons of 1904 and 1905, when the potato crop was seriously affected in some sections. The trouble is due to a fungous disease which flourishes only in seasons when the weather is wet and muggy. It seldom does much harm to the early varieties that ripen previous to the first of August, but the late crop may be ruined when the weather during the month of August is favorable for the development of the disease. In 1906, the weather in most parts of the state was comparatively dry during the months of August and September, and in those sections little harm from the rot was experienced. It has long been known that the disease which causes the blight of the vines and the rotting of the tubers can be almost entirely prevented by the use of fungicides, the most effectual of which is Bordeaux mixture. For the season of 1906 a series of co-operative experiments were arranged and in most cases it was found that the injury from the disease was not sufficient to warrant more than one or two applications and these would be made more for the control of the potato beetle and what is known as "early blight," than for the true blight and rot of the potato which is properly called "late blight."

FIG. 6. Deming Power Outfit.

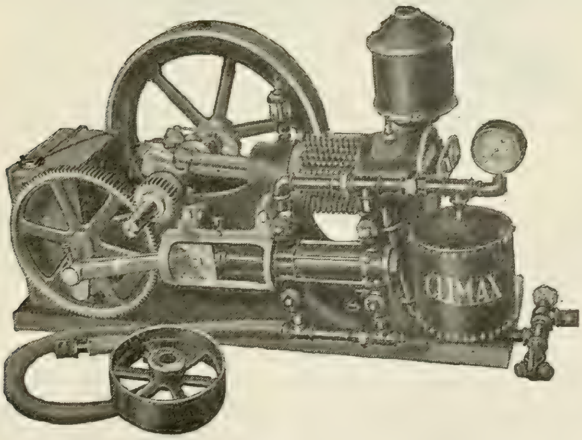


FIG. 7. Wallace Spraying Outfit.

As the character of the weather for a given season cannot be foretold, it is impossible to prescribe any definite number of applications that should be given the potato for the control of this disease. All applications are designed to prevent rather than cure the disease; hence, if delayed too long, the desired results cannot be obtained.

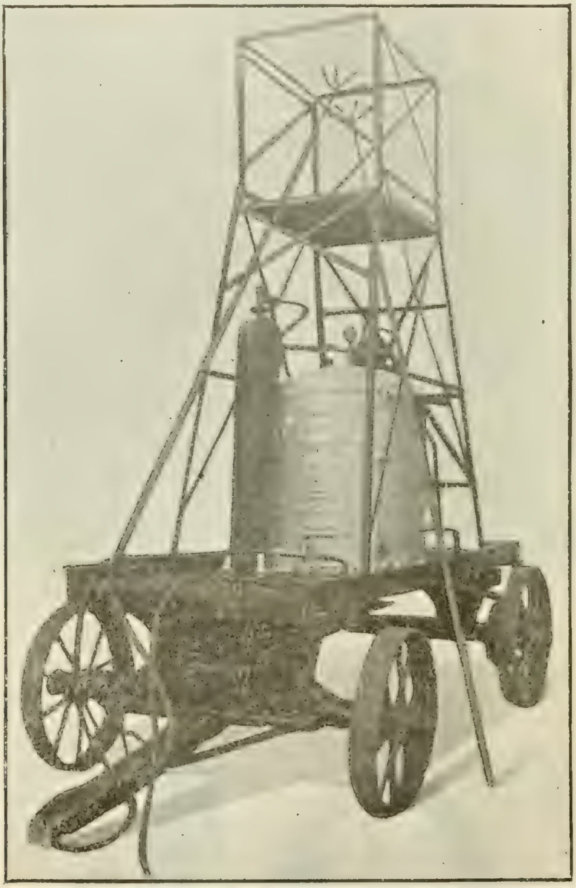


FIG. 8. Gas-Power Spraying Outfit.

Under ordinary conditions one or even two applications of Bordeaux mixture with an arsenite can be used with profit. They should be used when the beetles become troublesome and when the first indication of early blight appears. Except in sections where true blight and rot have been quite troublesome it may not be advisable to make other applications unless the climatic conditions are favorable for the development of the rot. If, however, the weather during the first half of August is wet and muggy, it will be a good plan to thoroughly spray the vines, and this treatment should be repeated at intervals of ten days to two weeks, provided the weather for the remainder of the month favors the appearance of the blight.

That this will give good returns can be seen from the fact that it is not uncommon to have from one-half to three-quarters of the crop destroyed by blight and rot, while four applications of Bordeaux will almost prevent it.

BORDEAUX MIXTURE AND ITS APPLICATION.

The formula for Bordeaux mixture and the method of preparing it is the same as for use upon fruit trees. Three or four pounds of sulphate of copper (blue vitriol), five or six pounds of lime and fifty gallons of water, together with eight or ten ounces of Paris Green, or two or three pounds of arsenate of lead, will be effectual against both the blight and beetles. In preparing the Bordeaux mixture, the lime should be care-

FIG. 9. Spraying Potatoes.

fully slaked and the sulphate of copper dissolved by suspending it over night in a coarse bag just beneath the surface in a barrel partly filled with water. Twenty-five pounds can readily be dissolved in twenty-five gallons of water. To prepare the mixture, take three or four gallons of the copper sulphate solution and, after diluting it to twenty-five gallons, add five or six pounds of lime which has also been diluted to twenty-five gallons. As they are poured together the mixture should be stirred so as to favor chemical combination.

POTATO SPRAYING OUTFIT.

When only a small area is to be sprayed it will answer fairly well if an ordinary barrel sprayer is used but there should be a horizontal spraying spar, at the rear of the wagon or cart upon which the barrel is placed. This should be connected with the pump, by means of a hose

and there should be one or two Vermorel nozzles so arranged as to spray each of four rows.

If this outfit is used the driver will have to operate the pump and when large areas are to be sprayed it will be advisable to use a traction outfit, of which several forms are manufactured. They are made especially for spraying potatoes and similar crops and are so arranged that the power for operating the pump is taken from the wheel of the cart by means of a chain and sprocket wheels.

GRAPE DISEASES AND THEIR TREATMENT.

The weather for the last two or three years has been very favorable for the development of the mildew and rot of the grape. Like the potato diseases, these are not generally prevalent unless climatic conditions are favorable for them. The so-called black rot of the grape is especially troublesome in years when the weather is wet and muggy and it also is most likely to occur during the months of July and August and the first half of September.

Like other fungous diseases the spores do not germinate unless the fruit and leaves are covered with moisture from rain or dew, and this condition is more likely to be met with in low lands and on north slopes where the circulation of air is restricted and where the drying effect of the sun is less than upon hillsides, and especially if they slope to the south.

The rot of the grape shows in numerous brown circular spots upon the foliage, in the middle of which there are minute black dots. Upon the fruit, it first appears as circular olive green spots a little larger than the head of a pin. These soon turn brown and enlarge until the entire grape is infected. At this stage it is of a brown color and, hence, the disease is often confused with the brown rot which is a name properly given to the rot caused by downy mildew. The diseased grapes soon begin to shrivel and in a few weeks the skin is drawn closely down around the seeds. By that time it has become of a dark brown, almost black color, from which appearance the correct name of the disease, black rot, is taken. About the time the shriveling begins, numerous black dots can be found upon the grape at the point where the rot started and these gradually spread over the entire surface. As indicated above, although the disease is of a fungous nature it is not troublesome except when the weather conditions are favorable. During the ten years previous to 1904 the months of August and September were comparatively dry and little harm was done. In that year the disease did considerable harm in Berrien and Van Buren counties and in 1905 and 1906 it spread to other vineyards and in most cases was even more severe than in 1904.

This disease has practically put an end to grape growing in many portions of Missouri, Illinois, Indiana and Ohio, where the soil and climate seem even more favorable than that of Michigan for the development of the black rot. It was found, however, that by the early and frequent use of Bordeaux mixture the disease could, for the most part, be held in check. In a general way, the treatment is the same as is recommended for the rot and blight of the potato. It is advisable, however, to make one application of Bordeaux mixture, or of copper sul-

phate solution (2 lbs. in 50 gals. of water), just before the growth starts and the vines should be sprayed with Bordeaux mixture as soon as the fruit has set. Whether other applications can be made with profit will depend upon the character of the weather during July and August. If wet and muggy, and the disease was present in the vineyard in previous years, it will be well worth while to repeat the application of Bordeaux mixture every two weeks up to the first of September, provided the weather during the period is favorable for the development of the disease.

No application of a fungicide will be found effectual unless it is made before the disease has developed and the treatment should be so thorough that every part of the plant is covered. In sections where the appearance of this disease may be expected it is advisable to so prune and train the vines as to permit of free circulation of the air. This will not only tend to dry off the vines and thus lessen the danger of the appearance of the disease, but it will facilitate the work of spraying and make it possible to cover not only the foliage but the bunches of fruit with the spray.

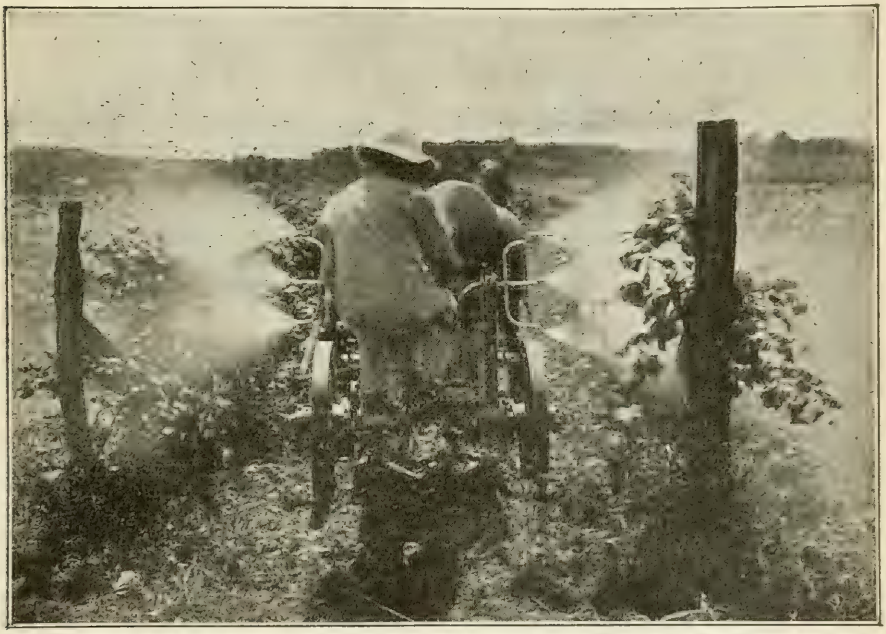


FIG. 10. Power Vineyard Outfit.

MACHINERY FOR SPRAYING GRAPES.

Special spraying outfits have been placed upon the market for use in vineyards. These do not differ materially from those described for spraying potatoes except that the spraying spars are arranged on either side at the rear of the cart so as to throw the spray horizontally against the vines.

Among the leading manufacturers of power outfits for potato and vineyard outfits are E. C. Brown & Co., Rochester N. Y., and Wallace Machinery Co., Champaign, Ill.

During the last year or two the entire crop in many of the large Michigan vineyards was destroyed by the black rot of the grape and in many the injury ranged from ten to seventy-five per cent. With a good outfit it is possible to spray an acre of grapes at an expense, for labor and material, of not to exceed eighty cents per application. While under the best of conditions this might not entirely prevent the rot in a vineyard where the loss would be fifty or more per cent if left unsprayed, it would reduce it to such an extent that the loss would be hardly noticeable, while a crop in which fifty per cent of the grapes have been attacked by the rot is practically destroyed.

THE MILDEW OF THE GRAPE.

Although its effects are seldom as noticeable as those of the black rot, the downy mildew of the grape has for two or three years caused nearly as much loss as the black rot. The injury from this disease is produced fully as much upon the foliage as upon the fruit itself. It gives the leaves a frosted appearance on the underside and the infected areas soon turn yellow. If considerable portions of the surfaces of the leaves are involved they will drop from the vines and as this often results in practically defoliating the vines, they are not able to ripen the fruit, which remains in a green or semi-ripe condition until destroyed by frosts. Upon the fruit, it first has a greenish brown appearance and in severe cases the fruit turns brown but does not afterwards blacken as in the case of the black rot.

The development of this disease is also influenced by the character of the season, but unlike the black rot it flourishes when it is cold and wet. Vineyards upon hillsides where the soil is well drained and of a sandy loam nature are much less injured by this disease than upon low level land, especially if it is poorly drained and the soil is heavy. This disease is one of the easiest to control by Bordeaux mixture. As a rule, three or four applications are all that will be required. The first should be given while the vines are dormant and the others at intervals of two weeks, beginning as soon as the fruit is set. Vineyards treated in this way will not only be free from mildew but the crop will ripen a week to ten days earlier than upon unsprayed vines, even though the attack is not severe enough to prevent the ripening of the fruit. By keeping the vines in a healthy condition they will be able to complete their growth and develop fruit buds for the crop the coming year.

SPRAYING THE ORCHARDS.

While it is impossible to give any very definite directions for the spraying of fruit trees, owing to the differences that will always occur, from the nature of the varieties, the character of the season as well as the effect of the soil and location, a few general directions for the spraying of orchard trees may be helpful. For the most part the materials will be the same for all classes of fruits, so far as the ordinary sprayings are concerned, and they should be applied at practically the same periods. It will, of course, occasionally happen that some of the fruits are attacked by insects that are not found upon other species and additional remedies will be required. Some slight modifications of the directions will be necessary to adapt them to local conditions, as, while two or three sprayings in a season may be sufficient in some cases, five to seven may frequently be made with profit in others.

THE APPLE ORCHARD.

To protect the foliage and fruit of apple trees from the attack of dangerous insects and diseases it is important that they be kept covered during the periods these insects and diseases are most likely to be troublesome, with such materials as will make it impossible for them to injure the trees. The disease that is most common upon apple trees is known as apple scab. This is a fungous disease which in some cases entirely ruins the crop and can be held in check by Bordeaux mixture. For the earlier applications use three or four pounds of copper sulphate and five or six pounds of lime to fifty gallons of water. Later, this can be reduced to two or three pounds of copper sulphate and three or four pounds of lime in the same amount of water. The foliage of apple trees is often destroyed by insects, caterpillars, canker worms and other leaf-eating insects, while the fruit is attacked by curculio and codling moth. For these and other chewing insects an arsenite, such as Paris green, can be used with good results at the rate of one pound in every seventy-five to one hundred fifty gallons of water, or better yet with Bordeaux mixture. This insecticide sometimes burns the foliage and it is also readily washed from the trees. The former can be, to a large extent, prevented by the addition of two pounds of lime for each pound of Paris green, or by applying it in Bordeaux mixture which contains an excess of lime. Another remedy which is preferred to Paris green from the fact that it does not burn the foliage and because it has superior adhesive qualities is arsenate of lead. This is generally used at the rate of two to three pounds in fifty gallons of water. Its one drawback is the high cost, which is about fifteen cents per pound or about four times as much as Paris green for the fifty gallons. While its use might not be warranted for the entire season, it will ordinarily be worth while to apply arsenate of lead for the last spraying in June and for the one given the second brood of codling moths in August. The above remedies

either alone, or in combination, will be found very useful upon all orchard fruits.

In spraying apple orchards the first application of Bordeaux mixture and arsenite should be made just before the blossoms open. If there is any doubt about being able to spray the trees at this time, it will be advisable to apply a solution of copper sulphate (two lbs. in fifty gallons of water) during the months of March or April. As soon as the fruit has set, another application should be made and this should be repeated at the end of two weeks. If the third application is washed off by heavy rains, or if conditions favor the development of fungi or leaf-eating insects, a fourth application should be made in about two or three weeks.

The above treatment should keep the fruit and foliage free from apple-scab fungus and hold the chewing insects in check. For the second brood of codling moths an application of arsenite should be made soon after the first of August, although if the insect has been very troublesome in previous years, or if there are unsprayed orchards in the vicinity, it will be well to spray the trees about July 25th and again between August 10th and 15th. If varieties are especially subject to the attack of apple scab, or if the season is favorable for its development, Bordeaux mixture can be used to advantage for winter varieties.

When an orchard is infested with San Jose scale and it has been thoroughly sprayed with sulphur and lime mixture in the spring, this will take the place of the Bordeaux mixture up to the time of the setting of the fruit. The treatment after that period should be as given above.

THE SPRAYING OF PEARS.

The pear is so closely related to the apple that the insects and diseases to which it is subject are for the most part very like those found upon the latter fruit and the same remedies can be used. The treatment outlined above will be found useful in controlling the leaf blight, leaf spot and pear scab, as well as the slug, codling moth and other chewing insects. Except in the case of a few varieties that are very seriously injured by leaf-blight and scab, it will not be necessary to spray the trees more than twice in June, while a third application during the latter part of July will hold the above diseases in check even upon such varieties as Flemish Beauty and White Doyenne. If the trees are attacked by the pear psylla, it will be well to spray the trees with kerosene emulsion (1 gal. kerosene, 1 lb. soap and 12 gals. water) just as the buds swell. This treatment will not be necessary if they have been previously sprayed with sulphur and lime.

PEACHES.

The treatment of peach orchards is quite similar to that of pears except that it does not need to be as continuous. It is of importance that the trees be sprayed for leaf curl previous to the middle of April, especially if the varieties are subject to the attack of this disease. The sulphur and lime treatment for the San Jose scale will be an excellent substitute for the copper sulphate solution which is ordinarily recommended for the leaf curl. In many cases there is no occasion for spraying after the trees have blossomed, except where the curculio, rot,

or other fungous diseases have been troublesome. As a rule, one application after blossoming will hold these in check, but as the foliage is quite tender, it will be well to reduce the strength of the mixture from one-third to one-half.

THE SPRAYING OF PLUM AND CHERRY ORCHARDS.

After the spraying with Bordeaux mixture, which should be given previous to the blossoming, it will generally be well to make two applications at intervals of ten days to two weeks, beginning as soon as the fruit has set and the husks have disappeared. When the varieties are subject to leaf blight, or rot, it will pay to make an application of weak Bordeaux mixture provided it can be done without spotting the fruit. Unless it can be applied at least two or three weeks before the fruit is to be gathered, it will be safer to substitute copper sulphate, or soda Bordeaux, for the regular Bordeaux mixture.

THE SPRAYING OF VINEYARDS.

For the fungous diseases of grapes it will be well to spray the vines very thoroughly with copper sulphate solution during the month of April, or early in May, and then apply Bordeaux mixture as soon as the fruit has set. If the weather is favorable for the development of black rot or mildew, the application should be repeated every ten days or two weeks as long as danger from either of these diseases threatens. If the rose chafer is troublesome, which is especially likely to occur when the vineyard is upon sandy soil and there is land in the vicinity that is uncultivated, it will be well to apply arsenate of lead at the rate of five pounds in fifty gallons. This can be used in Bordeaux mixture if it is desirable to spray with a fungicide at that time. The same treatment will also prove very effectual against the flea beetle, which appears as the buds are swelling. At that time it can be used in connection with the spray of copper sulphate solution.

THE BUSH FRUITS.

The raspberries, blackberries, currants and gooseberries, which are commonly spoken of as bush fruits, are also benefited by spraying. Although the two first named fruits are not very much injured by insects they frequently suffer from the various cane diseases and an application of the Bordeaux mixture, when the new shoots are about eighteen inches high, will greatly reduce the injury from these troubles. A second application at the end of two weeks is also helpful. Care should be taken to spray the young growths thoroughly, but little will be gained by treating the old canes at that time. After the fruit has been gathered and the old canes removed, another application of Bordeaux mixture can often be made to advantage.

The currants and gooseberries will require early and frequent treatment. As soon as the leaves appear upon the gooseberries, careful watch should be kept for the currant worms, which can then be found upon the inside leaves on the lower portion of the plant. It will be well to apply Paris green in Bordeaux mixture and repeat the application upon both currants and gooseberries in about ten days or two weeks,

depending upon the prevalence of the worms. A second application two weeks later will keep the bushes free from the currant worms and also save the foliage from the attack of the mildew and leaf blight, both of which are quite troublesome. For the varieties of the English gooseberry, however, it will be well in the work of spraying to use liver of sulphur at the rate of three ounces in ten gallons of water every ten days up to the time the fruit is ripe.

Some of the varieties of strawberries are also much injured by leaf blight. This can be greatly helped if the vines are sprayed with Bordeaux mixture just before the blossoms open. This will not only reduce the amount of blight upon the foliage but will ward off its attack upon the fruit stalks. As they are very slender, the stalks and the fruit borne upon them are destroyed by very small spots.

Agricultural College, Mich., March 15, 1907.

REPORT OF THE SOUTH HAVEN SUB-STATION, 1906.

Special Bulletin No. 38.

Prof. L. R. Taft, Horticulturist:

Sir:—The following report upon the work of the South Haven Sub-Station for the year 1906 is herewith submitted:

Several changes have been made in the orchards during the year. The grape vineyard east of the residence was removed and a considerable number of the older apple trees that have been tested for sixteen to eighteen years were taken out. The original planting of all trees was at one rod square with the idea of utilizing the ground to the best advantage. In most cases two trees of a variety were planted so as to secure a fairly accurate test of each kind. From the very beginning the plan has been to remove one tree of each sort as soon as they commenced to crowd seriously. This has now been done in the case of nearly all of the apple trees along the north side of the grounds. In the southeast block the growth of the trees has been somewhat checked by heading back the leading shoots every year or two so that, although the trees are fifteen years old, they have not grown together. Many of the trees have borne five or six good crops and as there are 160 trees to the acre, while there would have been only thirty or forty trees if planted at the usual distance, it can be seen that the close planting of an orchard has its advantages. It will not be desirable to allow the trees to grow for many years more at this distance. One-half of the trees should soon be removed and they can then be left for several years when one-half of the remaining trees should be taken out.

While it has always been the policy to encourage the visits of fruit growers, for a number of years the work at the station has been considerably interfered with by throngs of resorters, most of whose visits were prompted by curiosity and to lessen the evil two visiting days each week were set aside for the general public. Persons desiring information or who are interested in fruit growing are always welcomed.

Although the season itself has been fairly favorable for the orchards and fruit plantations, the peaches, raspberries and other tender fruits were quite seriously injured owing to the mild winter which caused many of the buds to start prematurely, with the result that they were affected by the cold which followed. During the summer a somewhat extended drouth prevailed and this tended to make much of the fruit undersized. The freeze of October 10 has also done considerable harm to the trees, especially the peaches and Japanese plums planted last spring. The older trees also appear to be severely injured and it may be found necessary to remove a considerable number of the kinds mentioned. The apples trees appear to be free from injury and the cherries, pears and European plums have not suffered to any marked extent.

STRAWBERRIES.

The experimental work with strawberries has not been as satisfactory as could be desired. The old plantation was renewed and everything promised well until the white grub made its appearance and destroyed many of the plants. The new patch was also attacked by cut-worms and considerable harm was done before they could be destroyed by the use of poisoned bran scattered along the rows. The greatest injury was done by cut-worms in the portions where the soil was light. The plants grown where the land was rather heavy and moist were not damaged at all.

The plants upon which the notes were taken were set out in the spring of 1905 in rows three and one-half feet apart and at a distance of eighteen inches in the rows. The earlier runners were removed and the others were trained so as to form an open hedge-row about ten inches wide. It is always desirable to secure a clover sod for a small fruit plantation but owing to the limited area of the station grounds this was not possible. The land was quite heavily manured and plowed in the fall and the plants were set as early as possible in the spring.

Aroma:—A pleasant flavored late berry of bright red color. Fruit large and firm. Holds its size well throughout the season. Plants are moderately good growers. Is not productive here. Staminate.

August Luther:—An early variety ripening with Excelsior and of about the same size. It is broad, roundish conical in shape and bright red in color. It does not bear as well as the Excelsior but is of better quality. A good early berry for home use and local market. Plants are medium sized and good growers. Staminate.

Botham:—Staminate. A large, roundish, deep red berry of good quality. Flesh light red and somewhat tender. Plants vigorous and thrifty. Bore well this season. Looks promising for a dessert and local market berry. Needs further trial.

Ben Davis:—Staminate. A thrifty, medium early variety with berries above medium size. Color a good dark red. Roundish conical in shape, firm and of good quality. Generally quite productive. Promising for dessert and market.

Brandywine:—Staminate. A popular mid-season to late berry of good quality, size and color. Plants are vigorous. Bears well but is at its best on fairly heavy soil accompanied by intense culture. Good for market and dessert.

Bederwood:—Staminate. The most productive in the patch but that is all it has to recommend it. It is soft, light colored and of poor quality. Considered profitable by some on account of its productiveness.

Cardinal:—Pistillate. The name implies its color which goes right through the berry. It is large, regular, conical in shape, of good size, and firm in texture. Its firmness, glossy color and size make it very attractive as a market berry. Its quality is a little strong for dessert purposes but makes it suitable for culinary uses. Bears well but does best on a fairly heavy soil. Mid-season. Plants are thrifty but are poor runner makers. The runners are slender and the plants on them far apart.

Commonwealth:—Staminate. A large, irregular conical berry with a blunt apex. Color dark red. The flesh is a deep, rich red and of firm

texture. Flavor mild, pleasant. Lacks juice. Plants are low, compact growers and are poor runner makers. Has not been very productive here. Needs further trial. Season late.

Clyde:—Staminate. One of the most productive but is too soft and too light colored to be suitable for market. Quality is only fair. It is a little better than the Bederwood in all of its qualities. On account of its productiveness some use it for market.

Challenge:—Staminate. A very attractive, dark red berry of mild and pleasant flavor. Form roundish conical. Flesh dark red and moderately firm. Plants are moderately vigorous and are only fair plant makers. The beauty of this variety is the only prominent feature it has. Mid-season.

Duncan:—Staminate. A long, broad, conical berry of dark red coloring. Ripens with Clyde. Quality fair. Texture firm. May prove promising. Needs productiveness.

Dunlap:—Staminate. Still probably the most popular berry grown. Fruit medium-sized, regular, dark red. Plant medium-sized, thrifty and very productive. Fruit runs small towards end of season when grown on light soils. Mid-season.

Ernie:—Staminate. A good variety on the proper soil, which is a fairly heavy, rich, moist soil. Fruit medium-sized, dark, glossy red, regular and smooth. Roundish conical in shape, firm in texture. Quality very good. Plants are vigorous growers and fruit stems hold fruit well up. When grown on light soils the berry is too small for any practical use. Mid-season. Productive.

Early Hathaway:—Not as early as Excelsior and not quite as productive, but a little larger. Quality about the same. It is doubtful if it will ever find a place in the standard list. Staminate.

Early Beauty:—Too much like the Excelsior to give it a separate description.

Excelsior:—Staminate. A standard early variety which is somewhat deficient in quality. Serves well for culinary purposes. Fruit medium-sized, dark red, nearly spherical in shape. Plants somewhat small, but numerous. It did not do well this year, the blossoms being nipped by frost. Generally productive.

Fairfield:—Staminate. Medium-sized. Ripens soon after Excelsior. Color a rather dull, dark red. Not as productive as Excelsior. Quality better. Its good qualities are not prominent enough to make it popular.

Gandy:—Staminate. Very large, roundish, conical. Bright red in color with the seeds a dark glossy red. Does not do well on our soil. Plants are large, thrifty and productive. Under proper conditions it is one of the most popular late varieties grown.

Gersonda:—Pistillate. A very productive, medium late variety. This year we have had it growing on a heavier and moister soil than heretofore, and it has developed size and color. Plants are thrifty, vigorous growers. The fruit this year was large, regular, smooth, roundish, conical. Quality good. Always productive. Good for market and kitchen uses.

Glen Mary:—Staminate. A large, handsome, productive berry of quite good quality. It is broad, conical in shape and is generally well formed. Holds size well through the season. Tips are sometimes white. Plants vigorous growers. A good market berry. Mid-season.

Howell:—Pistillate. A mid-season variety of good size and quality. Roundish, and handsome but often irregular in size. Not productive enough to take a place with the standard varieties. Plants moderately vigorous.

Kittie Rice (Downing's Bride):—Pistillate. Fruit large, roundish, conical, of bright red color and one of the most smooth and regular in the patch. Flesh is firm and of good quality. A very attractive berry and desirable for dessert or market. Only a moderate bearer here but on rich soil it does very well. Plants are vigorous, upright growers. Mid-season.

Louis Hubach:—Pistillate. Medium early. Light red in color. Flavor acid and texture firm. Bore well this year. Plants are good growers. Looks promising as a medium early variety. Needs further trial.

Lincoln:—Pistillate. Medium sized, of rather dull red color. Flesh very firm and red. Quality good. Berry smooth and generally well formed. Plants moderately good growers. Fairly productive. Has no prominent good qualities to place it with the standard varieties.

Missouri:—Staminate. A moderately large, soft berry of a rather mild and poor quality. Red to dark red in color. Plants are large, thrifty growers. Bears fairly well. Not promising.

Lyon:—Pistillate. Medium-sized. Fruit long, conical, and necked. Color a rather dull red. Texture soft and tender. One of the most disagreeable berries to pick. Fruit stems are long and slender. Fruit lays in dirt and calyx pulls off easily when picking. Quality fair. Productive but good for no purpose.

Marshall:—Staminate. Has many excellent features. Quality, color, size and shape can hardly be excelled. The only objectionable feature of this variety is that the plants are poor runner makers. This can be greatly remedied by setting the plants close or setting them in a rich, moist soil. We had very satisfactory results this year by doing the latter, and the plants are healthy and vigorous. Good for all purposes but had best be grown for fancy market or home use. Medium late season.

McKinley:—Ripens with and similar to New York. Needs no other description.

New York:—Staminate. Medium late. Large, irregular, ridged, dark red in the sun. Under side and tips apt to lack color. Tender in texture and does not stand shipment well. Of good quality but lacks juice. Plants large, vigorous growers. Bears well. Not a canning berry but will do for local markets.

Nettie:—Pistillate. Very large, broad, conical, irregular. Quality very good, being better than in Gandy. It lacks color and is only moderately firm. Needs heavy soil to make a good growth of plants which are generally vigorous and healthy. Promising as a late variety.

No. 2:—Pistillate. From J. K. Bowman, Havana, Illinois. A medium to large berry, red in color. Quality fair but lacks juice. Bears well. Flesh light red and firm. Plants good growers. Promising as a mid-season market berry.

Nick Ohmer:—Not productive here. Fruit is large, roundish, conical. Color handsome dark red. Quality very good. Plants large and vigorous. Under better conditions this would undoubtedly be a good variety for a fancy market. Staminate. Mid-season.

Olive's Pride:—Staminate. A moderate bearer of fairly good quality. Irregular in shape, generally broad-conical with blunt apex. Fruit runs small towards end of season. Plants are good growers. Fruit stalks are long and strong and hold fruit up well. Has no especially good qualities to make it popular. Mid-season.

Oom Paul:—Staminate. A medium large, dark red berry of only fair quality. Flesh is red and firm. Plants are large and vigorous. The blossoms are easily frosted and for this reason the fruit was very irregular this year. Generally productive. A good berry but not sufficiently so to be popular. Mid-season.

Parson's Beauty:—Staminate. A rich, red berry of medium size. Is of good quality and makes a good canner. It is firm and does well for market. Sometimes a little irregular in shape. Seeds numerous. Generally productive. Plants healthy and vigorous and make a good row. Mid-season. Should be given a trial.

Ridgeway:—Staminate. A medium-sized berry of attractive red color. Flesh is evenly colored with a light red, and is tender and juicy. Quality is very good. It is not at its best here as it needs a rich, moist soil. Under proper conditions it is a very satisfactory berry especially for local market and dessert. Mid-season.

Rickman:—Staminate. A large irregular-shaped berry of dark red color. Flesh somewhat mealy but the texture is firm. Plants do not seem to be very thrifty growers. Not promising. Medium early in season.

Rip Snorter:—Staminate. Large, roundish, oblate, irregular, firm and of fair quality. Color bright red. Plants strong growers. Fruit stems hold fruit up well. Will not be popular. Mid-season.

Rough Rider:—Staminate. A large, late variety. Irregular, broad, conical. Color bright red, and quality good. Plants are healthy and vigorous but are only moderate runner makers. Bears best during its second year's fruiting.

Sample:—Pistillate. One of the best late varieties. Fruit is large, well colored with bright red, and of good quality. Always productive. A good all around late berry. Plants are thrifty and vigorous.

Springdale:—Staminate. A broad, short, conical berry of bright red color. Moderately firm. Quality good. Season is short and the berries run small toward its end. Plants good growers. Mid-season.

Seaford:—Pistillate. Medium late. A good grower. Berry is long and necked. Calyx comes off easily. Color is a handsome, dark red, which goes to the center of the berry. Quality is very good. Would make a good canning berry. Productive. For market its form is against it and it ripens with many other good berries.

Tilghmam:—Pistillate. Long, broad, conical, similar to Haverland. It is a little lighter in color. Quality good. Generally bears well. Plants are good growers. In general not as good as the Haverland and cannot be recommended to supercede it. Mid-season.

Tama Jim:—Staminate. A fairly large berry, conical in shape and often irregular. Color is bright red with the flesh a very light red. Quality is good, season late and texture tender. It has nothing that would make it prominent as a late variety. Not very productive.

Warfield:—Pistillate. A popular, medium-early variety. The most productive in the patch this year. One of the best for canning, the flavor being rather tart and the color dark. The berries run small after

the first few pickings. The plants are small but are good runner makers. Its prominent place has been generally taken by its seedling, the Dunlap.

The following varieties have fruited here for the first time this season:

Hocking No. 5:—Pistillate. From Flansburgh & Potter, Leslie, Mich. A medium to small berry of deep, glossy red. Roundish conical in shape but somewhat irregular and nubby. Quality is fair. Plants are thrifty, compact growers. Has not shown any promising features yet. Needs further trial.

Lucas:—Staminate. Medium-sized, oblate conical, firm and of fair quality. Plants are large, healthy growers. Had a fair crop this year. Needs further trial.

Lincoln Seedling:—Staminate. From C. E. Whitten, Bridgman, Michigan. Shape long conical. Medium size. Color bright red. Texture is somewhat soft. Plants are good, thrifty growers. Bore very well. Promising as a medium late variety.

Schreiber:—Staminate. From A. Schreiber, St. Joseph, Michigan, who thinks it is a cross between the Barton Eclipse and Dunlap. It is a large berry and well colored. Flavor mild and pleasant. Texture is only moderately firm. The plants are strong, vigorous growers, making a low, compact growth. The variety has done well on a light soil. Bore well. Looks promising but needs further trial.

GOOSEBERRIES.

Although the gooseberry plantation is, for the most part, ten years old with some of the plants even older than this, it is still in good shape and bore a very good crop. The American kinds seem to stand rather longer than the European varieties even though the mildew, which is the greatest enemy of the latter sorts, is kept in subjection. This is partly due to the fact that the stem borers are less troublesome to the American varieties. One of the principal difficulties in growing the gooseberry is the currant worm, which appears as soon as the leaves develop and seems to prefer the foliage of the gooseberry to that of the currant. We have found no difficulty in controling it if one or two applications of Paris green, or some other arsenite, are made as soon as the worms appear. By examining the leaves on the lower and inside portions of the bushes, the presence of the young worms can be detected by the numerous holes they make in the leaves. They can often be found there a week or ten days before they show on the upper portion of the plant and at this time they can be very readily destroyed.

Although the American varieties are not seriously injured by mildew there are one or two forms of leaf blight that attack the plants, especially in a dry season, and in some cases cause most of the leaves to drop before the fruit has ripened. The use of Bordeaux mixture in the same application with the arsenite will hold this in check. For the mildew upon the European gooseberries it will be necessary to supplement the two applications of Bordeaux mixture which have been made at intervals of ten days or two weeks, with two or three sprayings of liver of sulphur, using about three ounces in ten gallons. With this

treatment and with favorable surroundings and soil, the European varieties will bear as regularly and freely as those of American origin.

The American varieties are more or less sprawling in their growth. This tendency can be counteracted and the formation of fruit spurs can be increased if the ends of the main shoots are headed back in the spring. This is seldom necessary in the case of European varieties and in fact the thinning out process is usually more necessary. By keeping the bushes well opened up it permits the free circulation of the air and the injury from mildew is much less.

The gooseberry is sometimes attacked by an aphis which causes the leaves upon the young shoots to curl and form rosettes. It seldom does much harm. If taken in time, the young lice can be destroyed by the use of strong tobacco water or kerosene emulsion, but after the rosettes have formed it is difficult to reach the insects and it will generally be best to cut off and burn the rosettes, thus destroying the insects.

Columbus (Triumph):—A vigorous growing, English kind. Plants are still in good condition. Always bears well. Fruit is large, smooth and of good appearance. Quality very good. A good market or home use variety.

Downing:—The most popular and profitable American kind. Plants eighteen years old and still vigorous. A compact grower. Very prolific. Good for all purposes.

Golden:—English. Medium size. Quality fair to good. Golden color. Plants are poor growers and lack vigor. Not to be recommended.

Houghton:—A vigorous American variety, producing a small, reddish berry of good quality. Only a moderate bearer. Color and size are against it for market or culinary purposes.

Industry:—A rather poor-growing, English variety. Berry is large, hairy, and reddish in color. Quality good. Only moderately productive. Not profitable.

Josselyn:—American. Plant quite vigorous and productive. Fruit of good quality and free from mildew. It varies in size, some seasons being larger than Downing and during others running quite small. Color and variations in size against it.

Lancashire:—English. A fair grower and moderately productive. Bears large, reddish berries of good quality. Not profitable.

Orange:—English. Produces the largest bush in the patch. Bears well of small fruit of rich golden color when ripe. Makes a very good ripe dessert berry, the quality being very good. Otherwise, on account of size it is not a valuable variety, although it always bears well.

Pale Red:—A good growing American kind. The berry is small and reddish, and is therefore not suitable for market. Quality good. Much like Houghton.

Pearl:—American. Plants moderately vigorous and productive. Makes a low spreading growth. Fruit is medium-sized and resembles that of the Downing, although distinct from that variety. Quality good. In general not quite as good as Downing.

Tree:—A late ripening American kind. Bush a vigorous grower but of spindling habit. Fruit is medium in size and quality, and is very green in color. Not valuable.

CURRANTS.

Most of the currants gave good yields of fine fruit. The aphis was the only insect that was at all difficult to control and this did little harm except upon Long Bunch Holland. Where this variety is grown it is well to spray the plants just before the buds open in the spring with rather strong kerosene emulsion in order to destroy the eggs which were laid the previous fall.

This fruit is also attacked by the insects and diseases mentioned as injuring the gooseberry, and they yield readily to the same treatment. It is particularly important that the leaf-blights upon the currant are controlled. These fungi seldom fail to appear and as they often cause the leaves to drop before the first of July it not only makes it impossible for the bushes to ripen the fruit, but they are not able to mature their growth and to develop fruit buds for the next year's crop.

The value of the currant crop depends largely upon the size of the fruit secured. While much can be done by selecting varieties that give fruit of a large size, the fact that most of these varieties have a large pith and are especially subject to the attack of the borer makes them undesirable in many localities. Thorough cultivation and the use of ashes and ground bone as fertilizers tend to considerably increase the size of the fruit and will often give a good return in the price received per case without considering the effect upon the amount of the crop. Judicious pruning will also improve the size of currants. Particularly when the plants are young and the new growths are a foot or more in length, it is a good plan to head them back to about six inches. This will produce large fruit buds and will have a corresponding effect upon the fruit itself The following varieties fruited here this year:

Champion:—A thrifty growing black currant. The berries are large and of good quality, but like all black currants the clusters are small and loose. One of the best for cooking, jams, etc. Bears well for a black currant.

Cherry:—A thrifty, luxuriant grower, growing very large, attractive berries, generally in compact, short bunches. Quality medium. A very good market currant bringing highest prices. Bears well. Subject to the attack of borers.

Comet:—One of the newer varieties of the Cherry type. Quality fair. Bushes vigorous growers. Clusters of fruit short and compact. Does not seem to be productive, otherwise a good currant.

Fay:—Growth and berry much like the Cherry. Clusters are larger and bushes slightly more productive. Quality medium. Would prefer it to Cherry.

Holland:—Long, loose, clusters. Berries small and fair quality. Season medium. Moderately productive. Not good enough to warrant recommendation.

Lakewood:—A vigorous grower, bearing large berries of the Cherry type. Clusters vary in length but are generally compact. Quality medium. Varies in productiveness. This year it bore a fair crop.

Lee:—A rather poor-growing black currant. Quality is only fair, as is also the productiveness. Not to be recommended.

London:—A well-known variety. Generally quite productive but it gave only a half crop and the bunches were rather loose. Bushes do

not seem as vigorous as in former years. Berries resemble Fay. Bunches are generally medium to long and compact.

North Star:—A very thrifty grower. Fruit medium-sized. Clusters moderately compact and medium long. Only a fair bearer. Subject to borers.

Pomona:—A comparatively new variety, producing a large, good-looking berry. Bunches are only medium large and are somewhat loose. Bushes lack in vigor and are only moderately productive. Cannot be recommended.

Red Dutch:—A very thrifty and productive variety. Berries are rather small and grow in medium long and compact clusters. Quality good. The size of the berry is somewhat against it as a market currant.

Raby Castle:—Plant vigorous and fairly productive. Berries are medium sized and of good quality. Clusters are long and moderately compact. Makes good appearance but is not productive enough for market.

Red Cross:—Of the Cherry type, growth resembles that of the Fay. Bunches are short and compact. Quality good. Needs further testing to determine its productiveness.

Select:—A large currant of the Cherry type. Quality medium. Clusters are compact. Only fairly vigorous. Not as good as Fay or London.

Versaillaise:—Berries of good size and quality. Bunches are long and compact. Bushes are moderately vigorous and bear fairly well. A seedling of the Cherry but not quite as productive.

Victoria:—A productive, moderately thrifty variety of good quality, but like the Red Dutch its berry is too small for a market berry. Quality not quite as good as that of Red Dutch.

Wales:—One of the best black currants. Fruit varies in size but averages large. Quality mild for black currant but is very good. Bunches are moderately large and compact. Bears fairly well.

White Dutch:—The best white currant on trial. Plants are vigorous and productive. Quality of the best. Berries are medium large, growing in moderately large, compact clusters.

White Gondoin:—Resembles White Dutch except that it is not as vigorous or productive.

Wilder:—A seedling of the Versaillaise. Bush a thrifty grower and very productive. Berries are large, being of the Cherry type. Bunches are long and compact. Quality good. One of the best for market or home use.

SMALL FRUIT PACKAGES.

A comparison was made between paper and wooden boxes as carriers of strawberries, gooseberries and currants. The paper boxes were furnished by the Mullen Bros. Paper Co., St. Joseph, Mich. The wooden boxes were from Pierce-Williams Co., South Haven. In packing the fruit the wooden box was easiest handled. It is also more suitable for picking the fruit. The paper boxes, however, were well made and all alike. Sometimes a wooden box was defective and would break at the corners. The crates of paper boxes looked more fancy when filled, but

the crate as a whole was less firm than the crate of wooden boxes. The smooth, waxed sides of the paper box was easier on the fruit than the wooden box. The fruit sold for the same price in both. The commission man preferred the wooden box, stating that when the crates containing the paper boxes were roughly handled the boxes would shift and press upon each other. The grocers also stated that the paper boxes were not firm enough for use in his trade. There is little difference in the cost. The price of paper box crates per hundred is $11.60, the crates being in the flat and including 1600 boxes made up. One hundred of the wooden box crates with 1600 boxes, both in the flat, cost $11.30. Of course, in considering these prices the extra work of making up the wooden boxes must be taken into account. In general, the paper box is undoubtedly easier on the fruit and will do for a special trade where care is taken in handling the crate, but for fruit going through the common channels of trade the wooden box is the best.

RASPBERRIES.

The new plantation of raspberries came into full bearing this year and gave a fine crop of fruit. The price received for the red raspberries was very low, due probably to the fact that the high prices received during recent years has caused them to be set largely in preference to the black raspberries.

For the production of this fruit, whether for home or market use, it is desirable to have a loamy piece of land which does not suffer, on the one hand from drought, and which is so thoroughly drained that the water is quickly carried off after a heavy rain. The character of the soil itself seems to make little difference provided it contains the proper amount of plant food and the above conditions are met. In most sections a slightly rolling piece of land is desirable but care should be taken, especially away from the shore of Lake Michigan, to avoid holes as there is likely to be danger from frosts while the plants are in blossom.

After having plowed and thoroughly prepared the land, it should be marked off both ways and furrows then be opened lengthwise of the field. The distances will vary somewhat according to the character of the soil and the variety, but if the distance between the rows is made eight feet, it will make it possible to do most of the cultivating with a harrow. If this is not desired, some varieties may be planted as close as six feet, although seven will be better for the larger growing kinds. As a rule, three feet answers very well for the distance in the rows, although under some conditions two and one-half feet might be desirable, and under others they may be as far apart as three and one-half feet. While the early spring planting of red varieties will give good results if the ground is not too heavy, it will generally be better to put out the plants in the fall, as they will have calloused and will be in good condition for growth when spring comes. If fall planting is practiced, it is always well to place a forkful or two or straw manure about each of the plants to prevent their being thrown out by freezing and thawing. On the other hand, it will be better and in most cases necessary to plant blackcap raspberries in the spring. Especially if the plants have been

set so that they can be worked with a harrow and cross cultivated, they will require very little labor during the first year. No pruning at all should be given the red raspberries, but if the blackcaps make a strong growth, they can be headed back when the canes have reached a growth of two feet. If the growth has been sufficient to furnish a crop the following year, the cane should be pruned in the spring. The red varieties should be cut back at the height of from two to three feet, according to the variety, and the side shoots upon both red and blackcap varieties should be pruned back to eight or ten inches.

This, in a general way, is the care that will be required in the years to come except that after the canes have fruited they should be cut away and only five of the strongest of the new canes should be allowed to grow.

After the first year it will be well to allow the suckers from the red varieties to fill in between the plants so as to make a narrow hedge row.

The following varieties of red raspberries fruited this year:

Bradley:—A large, coarse-grained berry of a deep, rich crimson color. Quality good. Plants are not vigorous and do not bear well. Would prove a good fancy berry if productive.

Brilliant:—A large, well colored and regular berry. Quality is deficient. A vigorous grower. Fairly productive. Will do for market.

Cuthbert:—The best berry for market or home use. Large, conical and of very good quality. Of beautiful, dark crimson color. Plants are vigorous and productive. One of the best for all purposes.

Eaton:—First fruited this season. A large, coarse berry, which crumbles easily. Quality good. Plants fairly vigorous. Needs further trial.

Early King:—Plants have not made good showing. Berry somewhat small but of good color and quality. Not a good market variety. Season early.

Herstine:—Plants not very vigorous nor productive. Berry is medium large and coarse. Of fair quality. Not valuable.

Loudon:—Popular in some places but is a poor plant maker here. Generally productive. Fruit of good size and shape. Quality fair. A good market berry where well grown. Subject to root-gall.

Marlboro:—A fine, large, round berry of very good color and appearance. A little lighter in color than Cuthbert. Quality very good. A firm, good shipper. Plants are not as vigorous or hardy as the Cuthbert. A good market berry.

Miller:—An early variety of good quality. Plants vigorous and productive but berry is small.

Phoenix:—A thrifty grower and a very good bearer. Berries are large, well formed and firm. Color is a little light. Quality fair. Will be a valuable market berry if it keeps up its productiveness.

Black Raspberries.

Black Diamond:—A strong grower producing a medium-sized berry of bright color. Somewhat seedy. It holds its size well to the end of season. Bore well this year. A good market sort. Mid-season. Quality fair.

Centennial:—Mid-season. Bears well but the fruit is too small for profit. Quality fair. Moderately vigorous. Not valuable.

Conrath:—A popular berry that ripens early and lasts through a long season. Of good size and bright color. Quality good. Plants only fairly vigorous. A little shy in its bearing qualities.

Cumberland:—The best blackcap in cultivation. It is a strong, healthy grower and very productive. Well shaped and of bright color. Quality good. Should be set for home use and market.

Eureka:—Fruit of good quality and color. Plants moderately vigorous. Berries held up well during the dry spell. Promising as a good market variety.

Gregg:—Although a standard kind it made a poor showing this year. The berries were ill-shaped and crumbled easily. Its whitish bloom is a drawback for market purposes. The Cumberland is now more popular.

Kansas:—Mid-season. A little earlier than Cumberland. The plant is a thrifty grower, and made a good growth this year. Generally bears well. Fruit varies in size, some seasons running rather small. This year it was ill-shaped.

Livingston:—A thrifty grower, being more so than Cumberland. Ripens with it but does not stand drouth as well. Fruit medium large and well formed. Bright in color. Valuable.

Nemaha:—Mid-season. Fairly vigorous but only a fair bearer. Seedier than the Cumberland and not of as good quality. Has white bloom. Medium large. Not a market berry.

Onondaga:—Produces a fair quality berry which is a little larger and a little earlier than the Cumberland. The berry is attractive and stands the drought well. Bushes are not over vigorous but make a good show.

Ramson Everbearing:—As its name suggests it bears throughout the season. Bears well but the fruit is too small to be valuable. Quality good. Plant moderately vigorous.

Purple Caps.

The purple cap varieties are supposed to be a cross between the red and black raspberries. The plants are generally strong and vigorous and quite prolific. Although the flavor is not such as to make them desirable for eating in a fresh state, they make excellent canning berries although their color and tenderness are against them for market purposes.

The fruit of the purple caps is similar to that of the red varieties while the growth of the plants is like that of the blackcaps.

The following notes were taken upon the purple cap varieties grown at the station during the past year:

Cardinal:—Its beauty is in its plant which produces a vigorous growth, with a bushy top, giving the row a hedge-like appearance. The fruit is of poor quality but is fairly firm, and the plants are quite prolific. Fruit is also rather small for purple-caps. Worthless.

Columbian:—The most valuable purple-cap. Bushes are very vigorous and prolific. The berry is large and of very good quality. Firm for a purple cap. Valuable as a canning berry for which purpose it is hardly excelled by anything in the raspberry line.

Haymaker:—Berry and growth similar to that of the Columbian. In flavor it is somewhat more acid than the Columbian and the berry is less firm.

Shaffer:—The oldest variety of the purple caps. The plants are not as vigorous as those of the Columbian nor are the berries as firm or of as good quality. Productive. Susceptible to anthracnose.

BLACKBERRIES.

Although the blackberry plantation is but two years old, an excellent crop was secured from nearly all varieties and, the winter being quite mild, all the plants came through in good shape.

The blackberry does well in practically the same conditions as those outlined for the raspberry, although as a rule it is well to give it somewhat heavier soil and, as the crop ripens a little later in the season, there is more danger from injury by drought. The blackberry should, if possible, be placed upon land where a plentiful supply of moisture will be provided even in dry years. The method of planting and growing the crop would be the same as the red raspberry although eight feet should be the distance used between the rows except perhaps for some of the smaller growing kinds. Summer pruning, that is, heading back the new canes is also generally necessary in order to keep the stronger growing kinds in shape. If they are headed back when they reach a height of from two and one-half to four feet, according to the growth of the plants, they can be readily kept in shape and by cutting off the side branches at a length of about one foot just before the growth starts in the spring, it will result in thinning the crop so that larger fruit will be produced and the injury from drought will be greatly lessened.

Among the kinds that fruited last year were the following:

Eldorado:—A medium early variety ripening a little before the Snyder. The plant is a hardy, vigorous, upright grower. The berries are large, firm and bright, making them very attractive. Quality is the best of the hardy sorts. Productive. A good market and dessert berry.

Erie:—Made the best showing this year. Plants are vigorous, upright growers, but are only moderately hardy. Berries are large, round and attractive. Quality very good. Very productive this year but former records show it to be only moderately so. Stands dry weather well. A good berry for fancy trade.

Minnewaski:—A late variety bearing large crops of good-sized berries. Of rather poor quality but a good shipper. Plants are only moderately thrifty and seem somewhat tender.

Mersereau:—A thrifty but somewhat tender variety. Berries are large, firm and attractive. Quality good. Bore a good crop this year. Promising.

Ohmer:—A late variety of vigorous but slender growth, giving it a somewhat straggly appearance. Hardy. Berries are medium large, of good quality and firm. A very good late kind.

Rathbun:—A very thrifty grower but only moderately hardy. Fruit medium to small. Quality fair. Productive. Season early. Growth spreading. Good.

Snyder:—One of the most vigorous kinds. Berries are small to

medium. Of good quality and firm. Very hardy and productive. On account of its size it is excelled by other varieties as a market berry. Mid-season.

Wilson:—An old standard variety that is surpassed by other varieties. Plant is vigorous but somewhat tender. Berries are large but cannot stand dry weather, and run small towards the end of the season. Where it can be well grown it is a large, attractive berry of very good quality. A good shipper.

CHERRIES.

As was the case with all of the trees upon the station grounds, the cherries were planted one rod each way. Up to the present time this has answered very well as, although the trees are sixteen years old, they have not occupied all of the space. The sweet cherries, however, are rapidly spreading out and for a permanent orchard it is evident that a distance of about twenty-five feet each way should be given this class of cherries. While the sour varieties of cherries can generally be grown for eighteen to twenty years when planted one rod apart, it will be better to have the trees twenty feet square.

When the trees were started they were pruned so as to favor low heads; the trunks being eighteen to twenty-four inches high. This has given excellent satisfaction as there has been comparatively little injury from the bursting of the bark which is so common upon trees with tall trunks.

The cultivation of the orchards for the most part has consisted of dragging up to the first of July and then seeding to some cover crop. This has given good results althougn it has been found necessary occasionally to seed the land to clover for a year or two. By cutting the crop and using it as a mulch under the trees this has given good satisfaction as it nas not only retained the moisture, but has added humus to the soil. The removal of the crop, however, tended to check the growth of the trees, especially in the summers when drought prevailed. The effect was so serious that it was found necessary to mulch some of the trees with straw manure. The use of the clover crop as a mulch for the trees as described above tended to ripen the growth in the fall and this results in giving the trees increased hardiness. The cherry trees upon the station grounds are almost ideal in form. In addition to low heads, they were pruned so as to give them a symmetrical form. During the first few years the ends of the branches were headed back, causing the more straggling varieties to thicken up but since that time, very little pruning has been done; being confined to keeping the heads properly opened up. This really required very little attention.

The following varieties will be found desirable for market: Dyehouse, Richmond, Montmorency and King Amarelle of the Morello class, Montrueil and Magnifique of the Dukes and Governor Wood, Napoleon, Schmidt, Tartarian and Windsor of the sweet varieties.

Morellos.

Dyehouse:—Ripens slightly before Richmond. The tree is not as thrifty as that of the above variety. The fruit is also more tender. Always productive. Quality good. A good early market variety.

King (*Amarelle*):—Tree a fairly vigorous grower but not as thrifty as Richmond. The fruit is larger than Richmond, firmer, of better quality and longer stemmed. Ripens with it. Seems to be a biennial bearer. Good for home use.

Minnesota:—A late ripening variety of very dark red color. The flesh and juice are also dark red. Ripens somewhat unevenly. Tree moderately vigorous and spreading. Quality good. A good late variety. Productive.

Montmorency (*Ordinaire*):—The most productive variety on trial. Ripens about a week after Richmond. The best market cherry.

Northwest:—Of the English Morello type. Of good quality for this type. Tree of dwarf habit and very productive. Lacks in vigor somewhat but is valuable as a late market variety.

Ostheimer:—Also of the English Morello type but a more vigorous grower than the above. Rather unproductive. Quality very good for this type.

Richmond:—Well-known as one of the best varieties for early market. The stone adheres to the stalk and often withdraws from the tender fruit when being picked. Good for cooking.

Sklanka:—A thrifty variety ripening with Richmond. The fruit is dark scarlet, of good quality and moderately firm. Is not productive enough for general use.

Suda:—More vigorous than others of the English Morello type. Fruit similar to that of Northwest. One of the most productive of this type. Valuable for late market purposes. Ripens about two weeks after Montmorency.

Weir:—Fruit greatly resembles that of Richmond and ripens at about the same time. The stem is a little longer and the fruit a little larger. Tree is not as thrifty as that of the above variety. Fruit is easier to pick. Productive.

Dukes.

Carnation:—Bears fairly well of large fruit of very good quality. Handsomely colored with dark red. Tree a very thrifty, upright grower. Ripens a few days before the Montrueil. Valuable.

Magnifique:—A late ripening variety. Ripens evenly for a Duke. Fruit is large and of good quality. Color light red. Tree vigorous and moderately thrifty. The little leaflets which adhere to the stem near its junction to the branch when picking add to the appearance of the packed fruit. The latest ripening cherry on trial. Valuable for late market.

Montrueil:—Probably the most productive Duke on trial. Of the best color, quality, and size. It ripens very unevenly, requiring picking over three to four times during the season. Also very apt to rot. Aside from these two points it is all that could be desired of a Duke cherry. Mid-season.

Olivet:—A popular variety in many parts of the country. With us, however, the tree is a very thrifty grower but a rather shy bearer. The fruit is large, round, of good, deep color and very good quality. It ripens very evenly for a Duke cherry. Very good for canning. Season early. Bore well this year. If it had productiveness it would be the best Duke under trial.

HEARTS AND BIGARREAUS.

Coe (*Transparent*) :—A medium-sized cherry of very good quality. Very regular in shape and amber in color, blotched with pale red. Tender and sweet. Season early. Tree is moderately thrifty, and spreading. Fairly productive. Valuable for home use.

Cleveland :—A very large, moderately early cherry of fair quality. Color is a bright red on amber ground. Tree is very thrifty and vigorous. Quite productive. Ripens with Black Tartarian.

Early Purple :—The earliest variety of cherry on the grounds. Color is dark purple or nearly black when ripe. Quality is very good and texture tender. The tree is a moderate grower, and fairly productive.

Gov. Wood :—A popular early cherry. Large, sweet and tender. Color yellow, blushed with red. The tree is very thrifty, and productive. Apt to crack. Good for early market and dessert.

Ida :—A fairly vigorous variety ripening with Gov. Wood. The fruit is larger and of better quality than the above variety. It is not very highly colored and shows bruise discolorations easily. Needs careful handling. Quite productive. Worthy of a place.

Mary (*Kirtland's*) :—Large and of very good quality. Season medium. Tree moderately vigorous and very productive. Color a light and dark red, marbled on a yellow ground. Inclined to crack. Valuable for home or market.

Napoleon :—The most productive of the yellow sweet cherries. Fruit large, heart-shaped and mottled with red. Texture firm and quality fair. The trees are hardy and thrifty. Very apt to crack when nearly ripe. One of the most profitable sweet cherries on trial. Mid- season.

Schmidt :—A very large and handsome cherry of good quality. The color is a glossy dark red. Flesh also dark red, and firm. The tree is most too thrifty to be productive. Bore an excellent crop this year, and the fruit brought the highest prices. Mid-season.

Yellow Spanish :—A well-known yellow, sweet cherry. It is larger and of better quality than Napoleon with which it ripens. Not as productive as that variety. Inclined to crack when ripening. Good for home use and market.

Windsor :—The most profitable dark-colored, sweet cherry on trial. It ripens after Napoleon. Fruit large, heart-shaped and liver-colored. Flesh dark and of very good quality. Tree vigorous and productive. Valuable.

PEACHES.

The peach orchard has had practically the same care as the cherries except that the heading back of the new growths has been continued. Although we have been able to secure fairly good results with the trees planted one rod each way, it will be better if they can be given a distance of twenty feet as, even though the trees can by proper pruning be kept within the smaller distance, they are more likely to be injured from drought and the fungous diseases are more troublesome than when the air has a chance to circulate freely.

During the eighteen years since the peach orchards were planted there has been an average of three hundred trees upon the station grounds but not to exceed five trees have been taken out by the yellows,

which indicates that this disease need not be a serious draw-back to the peach industry if proper attention is given to trees when they are attacked by it. During the last two or three years most of the older trees have been removed and the orchards now consist largely of trees from one to four years of age.

The following are the only ones that fruited last season:

Admiral Dewey:—A large, very juicy peach ripening about the middle of August. It is a free-stone of fairly good quality. The color is yellow overlaid with two shades of red. The flesh is rather coarse. Tree is fairly vigorous and bears young. Not very productive this year.

Advance:—Ripens with Dewey. The fruit is large, firm and semi-cling. The color is white, overlaid with light red. Tree moderately vigorous but not sufficiently productive to be recommended. Quality good.

Banner:—Ripens with Smock. Yellow, free-stone and of good size although not quite as large as Smock. Of better quality and appearance. Tree thrifty and hardy. Productive.

Capital:—Ripens late. Color yellow with a deep purplish red cheek. Quality fair, rather dry. Free-stone with flesh reddish-yellow at pit. Tree thrifty and hardy. Not productive nor promising.

Carman:—A large, white peach ripening about the first of September. Texture tender and flavor insipid. Semi-cling. Tree a vigorous grower and only moderately productive.

Early Tallman:—A small, white-fleshed peach ripening with Triumph. Tender and of fair quality. Semi-cling. Tree a thrifty grower but unproductive. Not valuable.

Hieley:—A large, oblong, irregular, white peach, ripening about the fifteenth of August. Flavor is mild and pleasant and the texture firm. Free-stone. The tree is fairly vigorous, a young bearer and fairly productive.

Triumph:—Early, yellow, medium large and semi-cling. Quality good, texture firm. The tree is thrifty and a good bearer. Would be a good, early yellow peach if it did not incline to rot.

Waddell:—A large, white peach of very good quality. Texture is a little tender. Ripens during the latter part of August. Semi-cling. The tree is a thrifty, stocky grower, a young bearer and prolific. Promising, but a white peach has no place in northern markets.

Wark:—Medium large, yellow, semi-cling and ripens during the third week in August. Quality is very good and the texture firm. The tree is a moderate bearer.

Victoria:—Medium large, white, cling-stone, ripening during the last week in July. Very tender and juicy. Needs careful handling. Not valuable except for early market.

For market purposes it will be desirable to rely almost entirely upon yellow varieties, selecting only a few of the earlier kinds and relying mostly upon those that ripen after August 25th.

The following will give good satisfaction in the "Peach Belt" and in sections of the state favorable to the growth of this fruit: Triumph, Admiral Dewey, St. John, Conklin, Engle, Hills Chili, Elberta, Kalamazoo (or New Prolific), Smock, Banner and Salway. Lewis, Early Michigan, Hale, Champion, Rivers and Lemon Free are excellent white-flesh varieties. Golden Drop and Hills Chili are the hardiest of the yellow kinds but require good soil, thorough pruning and thinning in order to have them of a desirable size for market.

PLUMS.

While the plum trees have not suffered seriously from crowding although but one rod square, eighteen or twenty feet would be better for orchard planting. These trees have also been grown with low heads and this has given good satisfaction. The leaf blight has been held in check by thorough spraying and there has been comparatively little injury from rot. Very little harm has been done by black knot, owing probably to the fact that the trees have been kept thoroughly sprayed. The older trees are now eighteen years old and all of the European varieties are in good condition. Satsuma and some of the Japanese kinds will soon have to be taken out.

The following list of varieties is recommended: Red June, Abundance, Burbank and Wickson of the Japanese varieties and Bradshaw, Stark, Lombard, Black Diamond (or Kingston), Grand Duke, Monarch, Shropshire and French Damson of the European plums.

Agen Prune:—An old French variety of the prune type. The tree is thrifty but only a fair bearer. The quality is good and it is desirable for canning purposes. The color is very dark purple but has an undesirable reddish tinge. Not valuable for market. Free from rot.

Abundance:—A popular Japanese variety. One of the best of this type for quality. Very tender and juicy when ripe. The trees are vigorous and young, prolific bearers. Very valuable for early market.

Archduke:—A large, oval, dark blue plum of rather good quality. Ripens early in September, shortly before the Grand Duke. Not as productive nor as large as that variety. The tree is vigorous but only moderately thrifty. The fruit is firm and a good shipper.

Arctic:—Tree is vigorous and thrifty. Very productive. Fruit is small, of fairly good quality and of a deep, rich purple color. Ripens about the middle of August. Very good for canning and fair for market. Apparently free from rot.

Bradshaw:—A large, purple plum somewhat tender in texture when ripe. The flesh is rather coarse and of fair flavor. The tree is fairly vigorous and productive. The trees growing here as Odell are identical with Bradshaw.

Burbank:—One of the best Japanese varieties. The tree is very vigorous and productive. The color is dark red on yellow ground with numerous yellow specks. Ripens during the third week in August. Quality medium and texture moderately firm. Of good size. Valuable for market.

Coe (*Golden*):—A very large, yellow plum of very good quality. One of the latest in season. Is firm and a good shipper. The tree is vigorous but not a very strong grower. Productive. A late market plum and the best of the Egg type.

Columbia:—A large, roundish plum of purple color covered with a bluish bloom. Quality very good and the texture firm. The tree is fairly vigorous and thrifty. Productive but late in coming into bearing. Ripens early in September. Good for market or dessert.

Diamond (*Black*):—A very large, handsome plum of a deep, blush-black color. The tree is thrifty and vigorous. Also productive. It is not an eating plum, but one of the best market varieties on trial. Ripens during the latter part of August.

Fellenberg:—A large, bluish plum of the prune type. The quality is good and the texture is firm. Apparently free from rot. The tree is of vigorous, low, spreading habit. Very productive. Ripens during the last week in August. Excellent for canning. Valuable for market.

French Damson:—Fruit is larger than Shropshire and not of as good color. Both points are against it for market purposes. Quality is good and makes it excellent for preserving purposes. The tree is very thrifty and bears well but is late in coming into bearing. Ripens during the second week in September.

Field:—Ripens with Bradshaw and resembles it, but is not quite as large or productive.

Grand Duke:—A very profitable plum, ripening about the middle of September. Very large, deep blue, and firm. Quality is only fair. The tree is fairly vigorous and only moderately thrifty. Very productive, and the fruit brings high prices. Valuable for market.

Hungarian:—Medium size, and nearly round. Quality is good but the texture is very tender. The flesh clings to the pit. The tree is vigorous and productive. Good for home use only.

Kingston:—A vigorous and productive variety of large size. Resembles Black Diamond and ripens with it. Quality a little better than that of Black Diamond. Very attractive and a valuable market variety.

Lincoln:—Ripens about the middle of August. Fruit large to very large. Quality very good. Tree is vigorous and productive. Excellent for home use and local markets, but too tender for the general market. Color a dull red.

Lombard:—Very productive. Fruit of medium size and reddish purple color. Fruit rots very easily and is somewhat tender for market. One of the best for canning purposes. Quality fair.

Middleburg:—The latest ripening plum on trial. Vigorous and productive. Fruit of medium size and medium in quality. Color is yellow, covered with a purplish red. Texture firm. A fair late market variety.

Monarch:—One of the best late varieties. The fruit is large, roundish, dark blue and of good quality. It is firm and stands shipment well. Does not rot badly and hangs well on the tree. The tree is vigorous and productive. Valuable for late market.

Murdy:—Large, roundish-oval, and reddish-purple in color. Quality good. Texture is somewhat tender. The tree is vigorous and of an upright habit. Productive. Good for market and culinary purposes.

Red June:—A profitable, early Japanese variety. Of medium size and of good quality. Form ovate with a prominent apex. Color red. Quality good; texture moderately firm. Cling. Tree is moderately vigorous and productive. Ripens during the latter part of July, and early August.

Satsuma:—This well-known Japanese variety does not do well here. It has lacked in productiveness during the last four or five years. The trees are failing and seem to be short-lived. The flesh is dark red and of good quality for culinary purposes but its peculiar flavor unfits it for use unless cooked. The fruit is medium large and dark red in color.

Stark:—Of the Gage type. Color greenish-yellow. Quality excellent, the best of the Gages on trial. Size medium and form roundish. The tree is a thrifty and vigorous grower. Productive. Ripens with

Spaulding. Unexcelled for dessert and culinary purposes. Good for market.

Shropshire:—The best Damson. The fruit is of a deep, blue color and is free from rot. Of right size for this type. The tree is vigorous and productive. Valuable. Ripens in September.

Spaulding:—A productive and vigorous plum of the Green Gage type. Quality very good, but not quite as good as Stark Gage. Slightly more productive. Somewhat subject to rot. There is not much difference between this and the above variety. Valuable for dessert, culinary and market. Ripens during the last week in August.

Victoria: A large, yellow plum partly covered and spotted with red. Subject to rot. Quality good, and texture firm. Oval in shape. The tree is moderately vigorous and thrifty, and is an abundant bearer. Rots too easily to be valuable. Ripens during the latter part of August.

Wangenheim:—A German plum of medium size and of good quality. Good for canning purposes. Color dark blue. The tree is a strong grower, and is productive. The fruit is firm and comparatively free from rot. Ripens during the third week in August.

GRAPES.

The station vineyards were planted in 1888 and have been trained upon a horizontal trellis. This consists of posts at the usual distance with a cross arm at the top upon which the wires are borne. The vines are trained upon this so as to have two canes in each direction from the top of the main stem. These are tied to the wires and no further attention is given in the way of tying or training unless the new canes make so rank a growth as to trail upon the ground in the way of the cultivator; in which case the ends have been cut off. If the vines send out too many shoots from latent buds, these are rubbed off to throw the entire vigor of the vines into the fruit bearing canes. The winter or spring pruning has followed the Kniffin system. This consists of the selection of four canes coming out from the main portion of the vine and heading these back so as to leave about ten or twelve buds upon each. All of the other canes are cut away except three or four upon a main stem, which are cut back to two buds. The shoots that develop from these will be used for the fruit bearing canes the coming year.

The vertical trellis is most commonly used in the sections of the state where grape growing is most extensively carried on. This has also been thoroughly tested at the station with good results. This consists merely of two wires fastened to the posts, the upper one at the top and the other about one-third of the way to the ground. While it is desirable to have the trellis five and one-half to six feet high, five feet is a more common height.

The following varieties will give good results in all parts of the state where grapes can be grown successfully: Moores Early, Worden, Concord, black; Delaware, Brighton, Vergennes, red; Winchell, Niagara and Diamond, white. The Campbell Early does well in many sections and is a very fine grape but is not always productive. Although of inferior quality, the Champion has been found a profitable grape in some sections on account of its earliness and productiveness

Brighton:—A large, dark red grape of high quality. The vine is vigorous and productive, and the bunches are large and shouldered when the fruit sets well. Should be grown near some strong fertilizing variety and on the vertical wire system. Valuable for home use, and for market when properly pollenized.

Catawba:—A well-known wine and table grape that does not ripen well here. Quite productive and of excellent quality when it ripens fully.

Concord:—The most profitable and popular grape grown. While a few varieties excel it in some points, none equal it as a general grape for market and culinary purposes.

Delaware:—The best red grape in quality. The fruit is small but grows in compact bunches. Productive and brings high prices. Valuable for market and dessert. One of the best for a fancy trade.

Diamond:—A very productive white grape ripening about a week before the Niagara. Its bunches are not as large as those of that variety, but the fruit is of much better quality. Very desirable for market or dessert purposes. Will give the Niagara a close run for popularity as a white grape.

Duchess:—A very good green grape in quality. Bunches are generally of fair size but sometimes small and badly mildewed. Ripens about the middle of October and is a very good keeper. Quite productive.

Diana:—A fairly productive reddish grape of somewhat foxy flavor. The clusters are rather small and are somewhat liable to mildew. It ripens early in October and is a very good keeper. Its quality greatly improves with keeping. Valuable for the home garden to be used for dessert purposes, and especially for storage.

Empire State:—A small-berried green grape growing in long shouldered bunches. They vary in compactness, some seasons being rather loose. Quality good. Productive. Ripens in the second week of September.

Jefferson:—A medium-sized grape growing in large, shouldered bunches. Quality very good. Fairly productive. A long keeper. Ripens during the third week in October. Valuable for home use.

Jessica:—A green grape ripening about the second week in September. The berry is of moderate size and is grown in medium-sized bunches. Of very good quality. Productive. Valuable for home use on account of its earliness.

Moore (*Early*):—A strong growing variety of black grape. Quality is very good but the fruit is tender and needs careful handling. Not very productive. Good as an early black grape.

Niagara:—The most popular green grape. Ripens during the third week of September. The berries are large and grow in very compact clusters. Somewhat deficient in quality. Its size and productiveness make it a valuable market grape. Somewhat subject to black rot.

Ulster:—A rather large, red grape of very good quality being quite sweet. Grows in medium-sized but very compact bunches. The skin is very thick, being a disadvantage for eating purposes. Very productive. Attractive. The bunches being compact and firm make it a good shipping grape. Valuable for home use and market. Ripens early in October.

Vergennes:—A rather productive, red grape of very good quality. The

bunches are long and moderately compact. Keeps well. Desirable for home use. Ripens during the latter part of September.

Worden:—A seedling of the Concord which ripens a few days in advance of that variety. Excels it in quality. More tender and not as good for shipping. This variety should be set for home use and for a fancy market.

PEARS.

Although practically all the pear trees upon the station grounds are standards, the trees have been so trained, by starting them with low trunks and heading back the branches for the first few years, that they resemble dwarf trees. This has resulted in securing trees with sound trunks which can be very readily pruned and sprayed and from which the fruit can be readily taken. A few trees have been lost from blight but they have been almost entirely of the Russian varieties, which are very subject to this disease. By promptly cutting out any blighted branches which appear, little harm has been done to the other trees. Leaf blight, scab, and leaf spot, as well as the attack of the slug and other insects have been kept completely under subjection by spraying with Bordeaux mixture and an arsenite.

Of the varieties adapted for general planting are the following: Clapp's Favorite, Bartlett, Howell, Flemish, Bosc, Keiffer, Seckel, Sheldon, Anjou, Lawrence, Winter Nelis and Danas Hovey. In soil adapted to the growing of dwarf pears the Duchess (Angouleme) and Louise Bonne will be as good as any. These require high feeding, thorough cultivation and severe pruning.

Angouleme (*Duchess*):—A large, rather coarse grained pear of uneven surface. Quality good when fruit is large but is poor when the fruit grows small. The tree is vigorous but only a moderately thrifty grower. Very productive. Best grown on dwarf stock. Valuable for market. Ripens the latter part of September.

Anjou:—A well-known variety of very good quality ripening early in October. The fruit is large, smooth and regular. A long keeper. The tree is very hardy and quite thrifty. Slow in coming into bearing. Thus far our trees have not borne well. One of the most valuable where productive. Does well on dwarf stock.

Ansault:—A medium sized pear of very good quality but of not very attractive appearance. The tree is moderately thrifty and vigorous, and is an abundant and early bearer. Ripens during the latter part of September.

Bartlett:—The most popular and profitable pear grown. The trees are vigorous and very productive. Comes into bearing young. Very attractive in color and shape. Quality good. Ripens early in September. Can be kept in cold storage to advantage.

Bloodgood:—An early pear, ripening during the second week in August. Size rather small. Color yellow sprinkled with russet. Quality very good. The tree is vigorous and very thrifty. Productive. A fine early dessert pear.

Bosc:—A well-known pear of high quality, of the long neck type. Due to its long neck the stem end is liable to break off in shipping. Color is yellow, well covered with russet. The tree is a thrifty and

vigorous grower but is not productive here. Quality of the best. Very valuable where productive. Ripens about the middle of October.

Boussock:—A large, attractive pear, roundish obovate in form. Color is deep yellow clouded with russet. The tree is vigorous and thrifty. Ripens with Bartlett. Quality good. Requires early picking.

Conference:—One of the newer varieties. Of the Bosc shape. Color is russet with blotches of greenish-yellow showing through. Not quite as large as Bosc. The quality is very good, sweet and rich. The flesh is fine-grained and of a rich pinkish color. The tree is vigorous and fairly thrifty. Bears well and started early. Very promising for home use and market, especially a quality market.

Danas Hovey:—One of the best pears in quality. The fruit ripens about a week later than Seckel. Is of better quality and a little larger than that variety. Always bears well but the tree is a very slow grower and therefore does not produce as much fruit as Seckel. Color yellow, well covered with russet. Most valuable for dessert and fancy market. Brings the highest prices.

Early Duchess:—Resembles the Duchess (Angouleme), but is smaller and about three weeks earlier. Valuable for market.

Elizabeth (*Manning*):—A medium small variety ripening about the middle of August. Quality is very good. Form roundish and color yellow with bright red cheek. The tree is very vigorous, thrifty, and productive. Valuable for dessert and market.

Fitzwater:—Fruit of medium size and good quality. Color yellow, well covered with russet. The tree is fairly vigorous and quite productive, but somewhat late in coming into full bearing. Has some value for market. Good for dessert. Ripens early in October.

Flemish:—A well-known pear ripening during mid-September. Of very good quality, size and shape. Is an attractive looking pear but scabs so easily that it is a poor market variety. Color is light yellow, sprinkled with russet. Reddish-brown on sunny side. The tree is very thrifty and vigorous. Very productive. One of the best for preserving and dessert. Good for market when free from scab.

Garber:—Of the Kieffer family, and resembles that variety in growth of tree and in fruit. Ripens a little before that variety. Not productive here. Not valuable.

Giffard:—An early pear of a short Bosc shape. Medium in size and very good in quality. Ripens early in August. The tree is a vigorous and thrifty grower. Color of fruit is greenish-yellow with a dull red cheek. Productive. Valuable for home use and early market.

Howell:—A well-known, valuable market variety, ripening about the middle of September. The fruit is smooth, well formed and of an even light yellow color. Quality fairly good. The tree is vigorous and productive. Its attractive appearance and productiveness make it valuable.

Kieffer:—Well-known for its vigor, hardiness, productiveness, keeping quality, and poor quality. This variety does not grow to full size here. It is nearly immune from blight and San Jose scale. Very valuable for market where grown to good size.

Lawrence:—An early winter variety of very good quality. Of medium size and of yellow russet color. The tree is vigorous but somewhat slow in growing. Productive. Valuable for early winter market and dessert.

Louise Bonne:—A popular, medium large variety ripening early in October. Oblong, pyriform in shape. Color greenish-yellow with a reddish-brown cheek. Quality good. Productive. Can be grown to advantage on dwarf stock. Valuable for market and dessert.

Osband:—A medium-sized pear of very good color and quality. Pyriform in shape. The tree is fairly vigorous and fairly productive. The fruit loses its quality soon after ripening. Good for dessert and early market. Ripens during the second week in August.

Rostiezer:—A rather small and unattractive pear of a dull greenish-yellow color with a dull, reddish-brown cheek, but the quality is of the very best. Ripens during the third week in August. Thrifty and productive. Valuable for dessert purposes.

Seckel:—Tree vigorous and symmetrical. Fruit small but of the best of quality. Very productive. Brings highest prices. One of the best for pickling. Tree is somewhat slow in growing. Very valuable for culinary, dessert and market purposes. Ripens early in October. Does best in rich soil.

Sheldon:—A medium-sized, roundish pear of good quality, ripening during the latter part of September. Color greenish-yellow, mostly covered with a light russet. Tree vigorous but only fairly productive. Very good for pickling.

Souvenir (*du Congres*):—Very large; in flavor and color similar to Bartlett. Ripens about the middle of September. The tree is vigorous, thrifty and productive. Somewhat variable, sometimes coarse. Its size, color and productiveness make it valuable for market.

Tyson:—Fruit medium-small and of unattractive color but of very good quality. Similar to Rostiezer except that it is a little larger and ripens a little later. Good for dessert. Very late in coming into bearing.

Winter Nelis:—A popular winter variety of medium size and very good quality. The tree is a thrifty and somewhat straggling grower. Productive. Color greenish-yellow, well covered with russet. Valuable for dessert and market.

APPLES.

During the past season the various tests of apples have been quite satisfactory except that the fruit of the winter kinds upon the trees at the time of the freeze, October 10th, was destroyed. The trees for the most part have made a good growth, except in some cases where it was checked by the drought. As the trees in the north blocks were beginning to crowd, they have been thinned, by the removal of the least valuable kinds, so as to stand about two rods each way. In the south-east block the experiment of holding the trees back by pruning in June so they can be grown as dwarf standards at the distance of one rod square has been continued with good satisfaction. The trees, as a rule, have been quite productive and as the orchard contains four times as many as would be found if planted two rods each way, the total crop obtained has been considerable larger than would have been secured had the trees been planted at the usual distances. The following varieties have given satisfaction: Yellow Transparent, Oldenburg (Duchess), Chenango, Shiawassee, McIntosh, Maiden Blush, Wealthy, Jonathan, Grimes

Golden, Baldwin, Hubbardston, Wagener, Northern Spy, Stark, Mann and Golden Russet, and of the sweet varieties, Golden Sweet, Bough, Bailey and Tolman. In the following list there will be found a number of excellent varieties for dessert: Early June, Early Strawberry, Benoni, Fanny, Fameuse Sucre, Louise, Ontario, and Red Canada.

Most of the varieties named above fruited upon the station last year and detailed descriptions are given below.

Arnold:—A cross between Northern Spy, Wagener and Esopus Spitzenburg. Large and of Spy shape. Color, clear yellow. Tree vigorous and very productive. Quality good. Color and tenderness are somewhat against it for market. Quite free from scab. Can be used for market and is good for home use. Season, middle of October to March

Bailey Sweet:—A large, beautiful, red apple of a very pleasant, sweet flavor. The tree is only moderately vigorous and makes a spreading growth. It is, however, a regular and abundant bearer. It ripens early in September and keeps until nearly the first of January. Its size, color and quality make a valuable market and dessert apple.

Ben Davis:—This well-known variety does not do very well here. It is comparatively small in size and of poor quality. We cannot hope to compete with the western and southern states in growing this variety.

Bietigheimer:—A very large and handsome fruit of coarse texture and poor flavor. Good for culinary purposes, but poor for eating. Of pale, creamy yellow color blushed with a handsome, bright red. The tree is an early bearer but lacks productiveness. Form, roundish oblate. It is most valuable for exhibition purposes. Good for cooking. Ripens during the latter part of August.

Borovinka:—A Russian variety ripening with Duchess, and much like it. The fruit is a little larger than of that variety. Fully as valuable in every way.

Bough (Sweet):—Ripens about the middle of August. Color yellow, sometimes slightly blushed. Bears fairly well and is one of the best early apples for local market and home use. During its season it has no equal as a culinary apple.

Bosnian:—A large apple, somewhat similar to Red Bietigheimer and ripening at about the same time. It is of very good quality for an apple of its size. Bears somewhat better than Bietigheimer. Good for cooking and exhibition. The tree is large and vigorous.

Chenango:—Of the "Sheepnose" type. Color is creamy white, striped with red. Quality is very good. Flesh juicy, tender and crisp. The tree is a thrifty and rather dense grower. It ripens through a long season, starting about the middle of August. Productive but a portion of the fruit is generally small and deformed. On account of its tenderness it is unfit for market except in a fancy way. Should have a place in every home fruit garden.

Cogswell:—A striped apple of good quality and roundish oblate in shape. The tree is a good grower and productive. The apple is firm, and would be a good market apple if it colored better. Season November to March.

Dudley:—A seedling of Oldenburg, of very good size and quality. It is roundish oblate in shape and creamy white, striped and splashed with red. The tree is thirfty and vigorous and quite productive. Ripens

during the latter part of August. A comparatively new variety. Texture somewhat tender. Promising for market and home use.

Early Harvest:—A medium-sized, clear yellow apple of good quality. The tree is fairly vigorous but only moderately productive. Texture is somewhat tender. Valuable only as an early home use apple. Ripens during the second week in August

Early Joe:—A roundish-oblate apple, very handsomely colored with red. Of excellent quality and of about medium size. Texture is firm enough to make it a good shipper. Ripens about the middle of August. Bears a full crop biennially. A very fine apple for a fancy trade if such can be had at its season. Tree moderately thrifty and vigorous.

Early Strawberry:—A small apple well striped with dark red. Of very good quality. Ripens during the latter part of August. Quite productive. Tree a vigorous grower. Suitable for home and dessert purposes.

Fameuse:—Commonly called Snow. One of the best dessert apples of its season. Medium in size. Color, yellow, well striped and overlaid with a dark, handsome red. Flesh white. Quality of the best. Somewhat inclined to scab. The tree is thrifty and productive. Fruit hangs well to tree. Ripens early in October. When fruit is free from scab and other imperfections it keeps until spring in cold storage. Valuable for market and dessert. Distinctively a northern apple.

Fameuse Sucre:—A sweet Snow. Shaped and colored like Fameuse. Its flesh is also white. Flavor is sweet and quality excellent. Not as productive as Fameuse and ripens a little earlier. Valuable for dessert.

Fanny:—An apple of good appearance and quality, ripening about the last week in August. Roundish, of medium size and well striped and overlaid with a handsome red. The quality is not as good as that of Early Joe but the tree is more productive and the fruit of slightly larger size. Comes into bearing moderately young. Desirable for dessert and fancy markets.

Garden Royal:—A medium-sized apple of very good dessert quality. Color is greenish-yellow, well covered with rather dull red. Skin is tender and quite easily russetted by spray. The flesh is a rich yellow color, very tender and of the quality. Varies in size and quality. The tree is thrifty, and an upright grower. A reliable biennial bearer. A valuable dessert apple but not profitable for market. Ripens about the first of September.

Grimes Golden:—A medium-sized, clear yellow winter apple of very good quality. The tree is vigorous and productive. Bears full crops biennially. Sometimes fails to develop its full size here. A fairly good keeper but is inclined to scald in cold storage. Where it is known it is a popular market dessert apple and it should have a place in the home garden.

Gideon:—A medium large, clear yellow applē with a slight blush, ripening about the middle of September. The tree is hardy and vigorous and bears well here. Quality is somewhat deficient. Texture is firm. Its firmness, attractiveness and productiveness make it a good fall market apple.

Golden Russet:—An old variety that has lost popularity since cold storage has come into use. It is still favored by many on account of its

keeping and dessert qualities. It is a little smaller than Roxbury and does not keep quite as long. It should have a place in the home garden.

Gravenstein:—A large, attractively striped apple of good quality. Ripens through a long season, starting about the first of September. The tree is only moderately vigorous but fairly productive. Somewhat tender in texture. Its size, color and quality make it a desirable market variety. Very desirable for culinary and dessert purposes.

Golden Sweet:—A regular, roundish-conical, yellow apple of very good quality. The tree is moderately vigorous and quite prolific, bearing good crops biennially. Ripens about the middle of August. Very good for dessert purposes, but not valuable for market.

Hubbardston:—A well-known commercial variety, ripening in October. Of large size and yellow color, mostly overlaid with attractive red. Of very good quality. The tree is fairly vigorous and very productive. Keeps until about the first of January. This variety should receive more attention from commercial growers. Very good for dessert and suitable for culinary purposes.

Jefferis:—A medium-sized apple of very good quality, ripening late in August. Oblate; yellow, striped with dark red. Flesh is crisp and tender and of very good quality. The tree is productive and fairly vigorous. The fruit ripens unevenly and is not very attractive. Very desirable for the home plat, but not valuable for market.

Jersey Sweet:—Medium-sized, roundish, and of very good quality. Color, yellow overlaid with two shades of red. Somewhat tender in texture and skin. The flavor is rich and sweet. The flesh is fine-grained and crisp. The tree is vigorous and very productive. Fruit is often irregular in shape and size. Very good for dessert and culinary purposes but lacks color and firmness to make it suitable for market. Ripens early in September.

Jonathan:—A very popular market apple of high flavor. Size medium; color bright red on a yellow ground. The skin is somewhat tender and russets easily from spraying. The tree is slender in growth and moderately vigorous, and can be worked on a more vigorous stock to advantage. Very productive. It does not reach its best size in this state unless grown on rich soil. Very desirable for dessert and culinary purposes, and where grown to good size most valuable for market, as it brings the highest prices. Season November to March.

Longfield:—Small to medium in size. Clear pale yellow, with a pinkish and brownish red cheek. A very hardy and prolific Russian variety. Flavor is too strong for a good dessert apple, but its productiveness, hardiness and attractiveness make it a desirable apple for market. Also suitable for culinary purposes. Ripens in October.

Louise:—A very productive apple of Fameuse type. Not as well colored and ripens earlier than Fameuse and McIntosh. Slightly larger than Fameuse. Scabs and shows bruises easily. Unless desired as an early variety, the above varieties are much to be preferred. Ripens during the latter part of September.

Lowell (*Greasy Pippin*):—A medium-large, clear yellow apple, regular roundish oblong in shape. Ripens late in August. Of very good quality. Flesh is tender and crisp. Fruit is apt to drop as it ripens. The tree is vigorous, thrifty, long-lived, and productive. Very good for dessert and culinary purposes. Its color detracts from it as a market apple.

Maiden Blush:—A very attractive, regular, oblate apple, colored with clear yellow and blushed with a brilliant red cheek. The tree is hardy and thrifty. A reliable cropper. The flavor is sprightly. Very good for market and culinary purposes. Also good for evaporating. Ripens early October.

Mason Orange:—A seedling of Yellow Bellflower. Yellow, with a faint, brownish-red cheek. Quality very good. The tree is moderately thrifty and vigorous. Fairly productive. Somewhat tender for market purposes. Suitable for home use. Season November to January.

McIntosh:—Of Fameuse type, but larger and of higher color. Form roundish-oblate, regular. Color mostly dark red, covered with a bluish bloom. Flesh white, sometimes stained with red. Skin rather tender and subject to scab. Quality very good. The tree is a moderately strong grower, hardy and productive. Very desirable for dessert and culinary purposes; also as a high-class market apple. Brings highest prices. Ripens early in October.

Mother:—A roundish-conical, striped, red apple of very good quality. The tree is a moderate grower and fairly productive. Only fairly vigorous. Texture is tender. Ripens September 20th. Desirable for dessert purposes. Too mild for culinary purposes and too tender for market purposes.

McMahon (White):—A large, yellow, roundish apple, ripening about the first of October. Its texture is somewhat tender lessening its value for market. The quality is very good but rather strong for eating although very good for culinary purposes. The tree is vigorous and productive. Comes into bearing early and quite productive. Good for home use and for market to some extent.

Northern Spy:—This variety, one of the very best winter varieties, is being set aside for other varieties principally on account of its slowness in coming into bearing and susceptibility to scab. The trees are very hardy and if worked upon bearing trees it will not be long before a crop can be secured. Under poor conditions it does not bear until it is sixteen to eighteen years old. Sometimes the fruit lacks color, generally when the tree is making fast growth and is slow in coming into bearing. It can be grown to advantage in a rather stony or gravelly soil that is not over rich in nitrogen and has plenty of potash and phosphoric acid. It should be more extensively grown as there will always be a popular demand for it and it is especially adapted to the conditions of the state.

Oakland:—A medium-sized apple of dark red color on a yellow ground. Oblate in shape. Quality very good, desirable for dessert. The tree is a rather slow grower, having a slender growth and spreading habit. Reliably productive. Flesh is white and somewhat resembles Fameuse in flavor. Good for dessert and market. Season November to March.

Oldenburg (Duchess):—Probably the most popular early apple due to the earliness in which it comes into bearing, its good size and appearance, and the thriftiness and hardiness of the tree. Deficient in quality. Very good for market and culinary purposes. The best of the Russian kinds. Ripens early in August.

Ontario:—A cross between Wagener and Northern Spy. In appearance much like Spy except that it has the oblateness of Wagener. Like Spy it often lacks color. In productiveness, hardiness and thriftiness,

it is between that of Wagener and Spy. Quality about equals that of Wagener. Season November to April. Desirable for market and dessert purposes.

Primate:—A very large, tender, yellow apple, ripening early in August. The tree is very thrifty and vigorous, and fairly productive. Of the very best quality, tender and juicy. Apt to water core. Very desirable for dessert purposes. A home garden apple.

Peter:—Very similar to Wealthy, but is smaller and more conical than that variety. In no way is it an improvement except that it seems slightly more productive. Ripens during the middle of September.

Red Canada (*Steele's Red*):—A medium-sized, winter apple of very good quality. Color is dark red on a yellow ground. Texture is firm and crisp. The tree is a medium grower and moderately vigorous. Not productive here but it does very well in other parts of the state. A rich, gravelly soil is preferred for it. Very desirable for dessert and for market when grown under proper conditions. Season January to May.

Red June:—Of medium size, deep red color and very good quality. The tree is vigorous and a good grower. Very productive. Texture is firm. It is very desirable for a dessert apple and for a special market. Ripens early in August.

Rambo:—Medium-sized, roundish-oblate, of good quality; color clear light yellow, striped with red. Tree vigorous and productive. Good for dessert, culinary, and market but surpassed by others for all these purposes. Ripens middle of October and keeps to December.

Ramsdell Sweet:—A medium-sized, oblong apple, of good quality. Color yellow well striped with dark red. Texture tender. The tree is vigorous, and a strong grower. Only a fair bearer. A good, sweet, autumn, dessert apple. Ripens the last of September.

Red Astrachan:—A large, attractively colored red apple. The red overlies a yellowish-green ground. Quality good but rather sharp for dessert purposes. The tree is a good grower and is moderately vigorous. A moderate bearer. The fruit ripens rather unevenly and needs several pickings. Somewhat tender for shipping. Very good for culinary purposes. One of the best for apple jelly. Ripens early in August.

Rhode Island Greening:—Although its color is somewhat against it for market, its excellent quality for both dessert and culinary purposes, its hardiness, productiveness, and good keeping qualities put it in the front rank. It is somewhat liable to scald in cold storage if not handled properly. The fruit is generally very regular and well-formed. Season December to March.

Roxbury Russet:—The most popular of the russets. Its principal cause of popularity is its very good keeping qualities. This, commercially, is not as important since cold storage has come into use. Its quality is suitable for both dessert and culinary purposes, firmness, reproductiveness and hardiness still keep it popular. Its good shipping qualities make it very desirable for foreign trade. Valuable for market and especially so for home use. Season January to May.

Sheriff:—A very hardy, reliable cropper, bearing fruit of good quality and medium size. Color is greenish mostly overlaid with dark red. Texture firm. A good keeper. Season November to March. Good for market and dessert.

Shiawassee (*Beauty*):—Of Fameuse type. More oblate, not as well

colored, and not of as good quality as McIntosh and Fameuse. Ripens about two weeks later. Flesh has the characteristic whiteness of this type. Not as easily russetted by spray or as liable to scab as the above variety. Valuable for dessert and market.

Stark:—The tree is vigorous, thrifty and very productive. The fruit is large, firm, of fair quality, and greenish-yellow in color. Often lacks color. Its productiveness, firmness and good keeping qualities make a good market apple. A very good shipper. Quality is deficient for dessert but is suitable for culinary purposes. Season December to May.

Stuart (*Golden*):—A rather small, yellow apple, regular roundish-oblate. Quality is very good. Firm and a good keeper. The tree is vigorous and moderately thrifty. A fairly good bearer. Very good to set in the home plat for winter dessert purposes. Too small for market. Season November to March.

Titovka:—A Russian apple of the Duchess type. Ripens at about the same time but is somewhat larger and more oblong than that variety. The trees are not as thrifty growers, and the habit is more open and spreading. Vigorous. Fully equal to the Duchess except in growth.

Tolman:—A popular yellow, sweet, winter apple. The color is attractive and its quality good. It is especially desirable for kitchen purposes. The tree is very hardy, moderately vigorous and quite productive. Texture is firm but on account of its color the fruit shows bruises easily. Very desirable for kitchen use and for market in a small way. Season October to March.

Wagener:—Very productive, often overbearing. Comes into bearing early, and is comparatively short-lived. Is often used as a filler. Form of fruit is distinctly oblate. Color yellow, striped and shaded with bright red. It is very desirable for dessert and culinary purposes. The tree is not a very thrifty grower. Season November to April. Fruit is apt to scald in cold storage. Valuable for market.

Washington (*Strawberry*):—A large, striped apple ripening late in August. Quality is very good and is desirable for dessert purposes. The tree is a good grower and is moderately vigorous. Bears well, and comes into bearing early. Texture of fruit is tender and does not stand shipment well. Very good for home use but comes at a time when there is plenty of fruit on the market that sells better.

Wealthy:—A thrifty and very hardy variety, ripening medium large, well-colored, striped, red fruit of good quality. Fruit ripens somewhat unevenly and is sometimes uneven in size. Drops rather easily when ripe. Quite productive. Ripens in October. Valuable for market, culinary and dessert purposes.

Wolf River:—A very large, handsomely striped apple, oblate-conic in form. The tree is a very hardy, thrifty grower and biennial bearer. It does not come into bearing very young. The fruit is of poor quality but its good size, color and regular form make it a good market apple. Ripens early in October.

Yellow Transparent: Ripens a little before Duchess. Of good quality but somewhat tender and on account of its color shows bruises easily. Its color is a very attractive yellow. It is superior to Duchess for both culinary and dessert purposes but does not bear quite as well. Brings highest prices. A valuable early variety.

Akin:—A very attractive, bright, rich red apple, oblate-conical in

shape. Very firm and of good quality which mellows up to a delicious dessert quality about the middle of December. An excellent keeper. The tree is moderately vigorous and bears well. Starts bearing moderately young. Looks very promising for dessert and market, especially fancy market. Size medium large. Flavor very pleasant, mild, sub-acid.

Arctic:—Bore first fruit this year. Somewhat late in coming into bearing. Fruit is large, roundish-conical and well-colored with a dull, dark red. Flavor is mild, sub-acid and quality very good. The texture is very firm and it has the appearance of a good keeper. Ripens early in October. The tree seems hardy and moderately vigorous. Will be valuable if it proves productive.

Barry No. 5:—Fruit is irregular in shape, generally roundish to oblate-conical. Basin is greatly wrinkled. Color is greenish-yellow well marked by russet, denoting a tender skin. Quality is fair, flesh firm and fine-grained. Not very productive thus far. Not very promising. Ripens October 15th. Medium size.

Benoni:—A very attractive, striped apple of very good quality. Rather small in size. Form irregular, oblate-conical. Texture firm. The tree is a large, vigorous grower. Thus far it has proved very productive. Comes into bearing rather late. Very good for dessert. Ripens during the latter part of August.

Boiken:—A large, oblate-conical apple of good quality and firmness. Flavor, a brisk sub-acid. Color yellow with a blush of red on the sunny side. The tree is a moderately vigorous grower and comes into bearing early. Fairly productive thus far. The flavor is a little too brisk to make it very good for dessert purposes but it is very suitable for culinary uses. Its attractiveness, firmness and good keeping qualities make it good for market purposes. Season December to May.

Milwaukee:—Of the Russian type. Very similar to the Duchess except that it ripens later and is a little larger. Comes into bearing early and bears fairly well. Good to extend the season of this type.

Newby (*Doctor*):—A medium-sized apple, roundish to oblong in form, variable. Color yellow, well overlaid with bright red. Bears well and begins bearing early. Quality good, suitable for dessert purposes. Promises well as a market apple. Season December to March.

Ratsbury (*West*):—Above medium size. Striped but lacks attractive color. Quality good. Flavor rich, aromatic, spicy. Skin is tender and apt to russet. Late in coming into bearing. Not very promising. Ripens during the latter part of August.

Ralls:—A popular, southern apple. Medium size, roundish-conical. Color yellow, striped and shaded with red. The color is not very attractive. Quality very good. Flavor is sprightly, sub-acid, rich. The tree is a moderately vigorous grower. Comes into bearing moderately early and bears fairly well. Seems to be a biennial bearer. Very good for dessert and market but on account of its color it will not become very popular as a market apple. Season December to April.

Springdale:—A medium-sized apple, mostly covered with a dull dark red. Oblate in shape. Very firm and a good keeper. Quality is good enough to be used for dessert purposes. A biennial bearer. Promising.

Winter Banana:—Fruit large, clear yellow with a brownish-red cheek. Flavor mild and aromatic. Quality very good. Somewhat irregular in shape, generally oblong-conical. A very good keeper and ship-

per. Tree is an early and abundant bearer. Not attractive enough for general market but very good for dessert. May do for special market.

CRAB-APPLES.

Dartmouth:—A medium large, brilliant variety of very good quality. Flavor is mild and rich and is suitable for dessert purposes. Texture is firm. The tree is vigorous and a fairly thrifty grower. Starts bearing quite early and bears well. Ripens during the latter part of August. Valuable for dessert, market and culinary purposes. Flavor is a little mild for jelly.

Excelsior:—Quite large, roundish; color pale largely overspread with light red. The color is very attractive. Texture is very tender and as the color shows bruises easily this variety needs careful handling. Flavor is brisk sub-acid. Quality good. The tree is a vigorous and healthy grower. Bears well biennially. Ripe during the latter part of August. Desirable for kitchen purposes. Too tender for market.

Florence:—A small, oblate crab-apple very handsomely striped with broad stripes of bright red on creamy yellow ground. The tree is vigorous and hardy. Very productive. Flavor acid. Texture firm. Its productiveness, firmness and attractiveness make it a valuable variety for market. Good for jelly and other home uses. Ripens during the third week in August.

Jelly:—A medium-sized variety, colored with bright red on yellow ground. Flavor is brisk sub-acid. The tree is vigorous and a very thrifty grower. Productive. Texture moderately firm. Color not very attractive. Ripens early in September. Very good for jelly. Being juicy it makes a large amount of jelly per measure.

Martha:—Large but not quite as large as Excelsior. In color somewhat like it, being pale yellow shaded with bright red. Flavor brisk, sprightly, sub-acid. Quality very good. Tree moderately vigorous and thrifty. Quite productive. Desirable for culinary purposes and for market to a slight extent. Ripens during the latter part of August.

North Star:—Medium small, bright red on yellow ground. Flavor sub-acid. Quality fair. Texture tender. Tree moderately vigorous and productive. Can be used for the kitchen. Not very valuable.

Quaker:—A medium sized crab with a brownish red cheek on a greenish yellow ground. The color is not very attractive. Flavor mild sub-acid. Quality fair. The tree is vigorous and a very thrifty grower. Only fairly productive. Not valuable. Ripens late in September.

Virginia:—Medium small, well colored, bright red. Flavor sprightly, sub-acid. Quality very good. Texture firm. The tree is vigorous and thrifty. Only a fair bearer. If productive, this variety would make a very good market variety. Good for culinary purposes. Ripens in mid-September.

Whitney:—Large, being the size of a fair sized apple. Color a dark red on a creamy yellow ground. The color is very attractive. Flavor is mild sub-acid, pleasant. Quality good. For dessert purposes this crab excels most of the apples ripening at this time. The tree is very thrifty and vigorous. Very productive. Very desirable for dessert, culinary and market purposes. Ripens about mid-August.

QUINCES.

The crop of quinces was rather poor this year, there being an exceptionally large crop last season. A few of the trees have been taken out on account of the blight but generally they have been easily taken care of in that respect by immediate cutting out of the affected parts.

The following varieties are on trial here:

Alaska:—Large, roundish-oblate, ribbed, irregular. Quality very good. The tree is hardy and productive. Starts bearing moderately early. Similar to Orange. Ripens early in October.

Angers:—Medium sized, roundish, necked, firm in texture. Quality good. Too small and comes into bearing too late to be of profit. Ripens late in October.

Champion:—Large, of good quality, firm, thrifty and prolific. Starts bearing young. Ripens in mid-October. Valuable for culinary and market purposes.

Fuller:—Large, of good quality, firm; ripens in mid-October. Inclined to rot. Does not bear enough to make it valuable.

Missouri:—One of the best. Large, of very good quality, firm, crisp and juicy. Vigorous and productive. Valuable for culinary and market uses.

Rea:—A seedling of the Orange. A larger and more profitable fruit. Quality very good. Not as large as the Missouri but more regular in form. Thrifty and productive. Valuable for market and culinary purposes.

Van Deman:—Medium size, of very good quality, somewhat irregular in form. Tree is not very thrifty grower. Growth slender. Quite productive. Ripens early in October.

NUTS.

The English walnut has been a failure here as we have been unable to get it to grow. The pecan has made a very vigorous growth but has not fruited yet. The Japanese walnut (Juglans Sieboldiana) bore a rather small crop. Many of the nuts were undersized. The trees seem to have been failing during the last two years.

Of the filberts both the Kentish Cob and the Cosford Thin-Shell are good. The Cosford is a little smaller and of thinner shell than the Kentish. The bushes of both are very thrifty growers and bear well. They are not, however, productive enough to make them profitable but are very desirable for home use, the nuts being as large as those bought in the store.

The chestnuts are the most promising of all. Paragon is the best variety. It is productive, large, attractive and of quite good quality. The tree starts bearing young. The Comfort is of about the same size as the Paragon but is not as productive. The other varieties are small and unproductive. The Japanese varieties are failures. However they make a handsome tree which might be suitable for landscape purposes.

SPRAYING.

The trees on the station grounds received the usual applications of Bordeaux mixture and an arsenite. This served to hold in check the attacks of the various leaf blights and little injury was done by insects.

In addition to comparative tests of the various remedies for the San Jose scale, which are reported in another bulletin, co-operative experiments in spraying for the second brood of codling moth were carried on in an orchard near South Haven. The trees in plot number one were sprayed with arsenate of lead (three pounds in fifty gallons of water) on August 1st. In plot two they were sprayed with the same mixture on August 1st and again on August 15th. In plot three the application was made on August 15th. Plot four was sprayed with Bordeaux mixture (three pounds copper sulphate, four pounds lime and fifty gallons of water) on August 1st. In plot five the trees were left unsprayed.

The freeze of October 10th destroyed the chance of getting definite results, but the fruit from plots one and two were less injured by the codling moth than those in the other plots. This indicates that it is well to spray the trees as soon as August 1st. The difference between plots one and two was not sufficient to warrant the expense of the second application.

The variety sprayed was Wagener, and as little injury was done by the scab even on the unsprayed trees, no benefit was observed from the use of the Bordeaux mixture upon plot four.

Especially in orchards where the coddling moth has been troublesome, it will be well worth while to spray the trees with arsenate of lead either in the latter part of July or early in August, and if the varieties are subject to the attack of the apple scab and the season is favorable for its development, the addition of Bordeaux mixture is advisable.

The October Freeze.

In the morning of the ninth of October there was a snow fall of from six to eight inches. In the afternoon and evening the sky cleared up and was followed by the freeze that was disastrous in its effects in the southern part of the fruit belt. At the Station at six o'clock A. M. the thermometer registered seventeen degrees above zero. Fruit growers in the vicinity reported as low as six degrees. The weight of the snow on the trees in full leaf and a full crop of fruit broke many of the limbs. The freeze destroyed practically all of the fruit on the trees. The unripe varieties such as Greening apples and the Keiffer pears had the appearance of baked fruit and the juice oozed out. The riper varieties such as the Jonathan apples did not present such a bad appearance. The exterior did not show it but the core was brown in the majority of cases. There was a greater proportion of solid fruit left of the riper varieties than there was of the later kinds. Peaches and grapes were all destroyed.

Of the trees, the peach generally suffered most. All show considerable injury to the cambium layer and the alburnum, or sap wood, the vital parts of the tree. Parts of some trees show a green and healthy

condition, but the trunk is generally injured down to the snow line, thus practically girdling the tree. The Japanese plums are nearly as seriously injured as the peaches. In low places and where the trees have made a thrifty growth the pear trees are very seriously injured. In many cases the wood has turned nearly coal black. In other localities the pears have not been injured at all, or only the ends of the new growth and the buds have been injured. The apple trees have not been injured to any extent, altho some report injury to young trees. Some varieties of sweet cherries have been slightly injured. Of the small fruits the raspberries and blackberries are the only ones affected.

The territory most seriously affected was a strip of from ten to twelve miles wide along the lake shore, from Saugatuck south. Weather reports show that the temperature at South Haven was the lowest in the lower peninsula.

One effect of the freeze was to kill the last brood of scale. The early broods were apparently not injured except, of course, on the injured trees. It was noticed that the trees infested with scale were more seriously injured than the others. This was especially noticed on pear trees where the degree of general injury was not so pronounced.

It is seriously doubted whether any practical or profitable treatment can be given the trees where the cambium layer and the sap wood are brown or black. The winter season ordinarily draws hard on the tree moisture and this will greatly hinder any chance of recovery. The ground being covered with snow, the roots and first six or eight inches of trunk are uninjured. All trees will undoubtedly show some signs of life but they will be weakened, and it is very doubtful whether they will produce enough to pay money and time spent on them. Young trees set last year can be cut down to the snow line and allowed to sprout above the bud and new heads formed from that. Older trees would not sprout satisfactorily to form good heads. The raspberries and blackberries can be cut back to the snow line and allowed to grow again.

CONCLUSION.

There is a steady increase in the interest taken in the Station. The correspondence is growing larger and many more are seeking information in person. Prominent among those interested are city people new in the culture of fruit. We encourage personal visits of fruit growers to the Station or, if that is impossible, the seeking of its information by correspondence.

FRANK A. WILKEN.

South Haven, Mich., December 21, 1906.

REPORT OF THE UPPER PENINSULA SUBSTATION FOR THE YEARS 1905 AND 1906.

LEO. M. GEISMAR, SUPERINTENDENT.

Special Bulletin No. 38.

The hope of being able to present at this time some definite results from winter wheat investigations, which have been carried on since 1904, led to the postponing of an earlier report for 1905, and the biennial report of the past two seasons is herewith presented. Unfortunately, these results, as hereafter related, are far from being definite as yet, though this is merely one of the disappointing instances which show that the solving of agricultural problems is frequently and often discouragingly slow.

The Upper Peninsula Substation was originated by an act of the legislature, approved in the early spring of 1899. The work, as far as experiments are concerned, began in the spring of 1900, but the area then cleared was so small and the season so adverse, that little work of permanent value could be expected. Plans were laid out whereby the first five years were to be spent in determining what could grow in normal seasons in the Upper Peninsula. The results obtained in 1905, therefore, represent the work of the fifth and concluding year of this series. Hereafter the energies of the station are to be devoted more largely to cultural methods, and to the adaptation of selected varieties to the peculiar conditions of this new country, the size of which, it must be remembered, includes two-fifths of the 58,915 square miles constituting the entire State; thus making the area of the Upper Peninsula alone greater than that of Connecticut, Rhode Island, Massachusetts and Delaware combined. The altitudes range from the level of the great lakes, or about 600 feet, to about 1,600 feet along the mineral ranges. It is obvious therefore that it will require many years to obtain the accurate records needed to determine either what to grow as the principal crops or how to grow them. Meanwhile it will not be strange if during the course of investigation there will be offered for solution some new problems which, directly or indirectly, may be related to the peculiar and in some respects unique features of the climatic conditions of this vast region.

The area available to crops is still too small to permit the growing of the great varitey of crops on areas large enough to compare safely the yields of adjacent plots. Draining and clearing, partly done recently and partly under way, will, to some extent, remedy this defect. Perhaps the most necessary work for the immediate future is that which would enable this station to determine the value of stump lands for agricultural purposes. The increasing correspondence of the station shows that, within the past three years, many portions of the Upper Peninsula are being rapidly settled by a progressive class of farmers

who have come from the older agricultural regions where the timber and stumps have long since disappeared. To them and the others who seem disposed to follow, the important question is to know the value which may be derived from lands upon which little if any of the machinery to which they are accustomed can be used during the several years while the stumps are decaying. The simple, yet very important question which this station ought to be able to answer in the near future is: How many pounds of beef, of mutton, of pork, or wool or butter will an acre of stump land produce? There are thousands of such acres now, and the rapid disappearance of the timber, due to its constantly increasing price, makes it safe to state that there will be hundreds of thousands of such acres within less than five years.

WEATHER CONDITIONS DURING 1905.

In the mean the weather conditions of the season of 1905 were favorable for all crops. The total rainfall during the six months of the growing season was 19.75 inches, as against 20.61 inches for the preceding season. The greatest depth of snow was 30 inches recorded on January 13. The snow was covered with crust several times during the winter, especially at the close of December and in the latter part of February. Beginning with the middle of March, the day temperatures were uniformally high, though the night temperatures, until the forepart of May, were generally below freezing point, and thus the snow did not completely disappear until the twenty-eighth of April, although the ground was mostly bare on the ninth of that month. Plowing was practically completed and the seeding well under way in April. May continued cold, and as growth started a week later than usual, there were no late frosts to damage vegetation or blossoms, except that corn was slightly injured late in the season on low ground. The usually cool summer nights were warmer than normal during August, and this did much to offset the lateness of the season. Two rather heavy frosts occurred on September 13 and October 6, with a killing frost on October 11. Permanent snow fell November 24, the ground being unfrozen at the time.

Several severe wind storms caused a partial destruction of fruit trees in the unprotected orchard. Windbreaks are essential on the south and west side of Upper Peninsula orchards.

WEATHER CONDITIONS DURING 1906.

In many respects the weather conditions of the season of 1906 were even more favorable than those of 1905, the most conspicuous exception being the early part thereof. The total rainfall during the six months of the growing season was 18.61 inches. The greatest depth of snow was 35 inches, recorded on February 4. Warm weather started with the beginning of April, the ground being partly bare on the 12th, and the last traces of snow having disappeared on the 19th. Night temperatures thereafter remained cold and were frequently below freezing point until May 12. The warm and often hot and dry weather which followed

intensified the usual rapid growth of spring vegetation until the 20th, when most of the new growth was killed by the heaviest frost ever witnessed that time of year. The strangest effect from this was that strawberry and apple blossoms, which opened within the following ten days, were generally blackened in the center, while the plum tree blossoms, which opened first of any, were not damaged in the least. No damage could be observed from light frosts which occurred May 28 and 29 and June 12, not even upon corn and buckwheat which, at the latter date, were several inches high. The same applies to two light early frosts which occurred September 1 and 28, and the season ended suddenly on October 11 with an unusually severe killing frost. The first snow, which partly remained on the ground, fell November 10, and the ground, though partly bare on the 18th, 19th and 20th, remained unfrozen.

The records of mean temperature and precipitation during the two growing seasons are shown in the following tables:

1905.	May.		June.		July.	
Date.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.
1	35	0	60.5	0.11	66	0.24
2	40.5	0.18	53	0	60.5	0
3	41	0.36	52	0	64	1.16
4	49	0.39	54.5	0.33	67	0.17
5	50.5	0	50	0.74	68	0.11
6	41.5	0.25	47.5	0.64	63	0
7	42	0.02	56.5	0.02	61	0
8	37.5	0.54	55.5	0	54.5	0
9	38	0	57	T	54	0
10	41	0.02	47.5	0.13	56.5	0
11	52.5	0	51.5	0.28	61.5	0
12	56.5	0	54.5	0	72	0
13	54.5	0.15	62	0	71	0
14	51.5	0.58	67	0.41	70	0
15	43	0.51	69.5	0.04	51	0
16	41	0.08	67.5	0	72.5	0
17	38.5	0.28	64	0.16	73	0
18	45	0.08	62	0	75	0
19	53	0	65.5	0	68.5	0
20	43	0	58.5	0	54	0
21	45	0	57.5	0.07	55	0
22	43	0	50.5	0	59	1.09
23	48	0	52	0	54	0.15
24	56	T	59	0.02	56	0.16
25	51.5	0.06	57.5	1.15	56	0
26	44.5	0	49	0.05	58.5	0
27	54	0	46	0	62.5	0
28	43.5	0	52	0	65	0.03
29	46	0	57	T	56.5	0.06
30	46.5	0	67.5	0	64	0
31	52.5	0.01	....	....	52.5	0

1905.	August.		September.		October.	
Date.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.
1	49.5	0	52	0.22	59	0.30
2	52	0	57.5	0.98	56	0
3	59	0.01	60.5	0.83	54	0
4	66	0.14	52.5	0.47	61.5	0
5	68	0.65	55.5	0	50.5	0
6	62.5	0.08	57	0	45	0
7	61	0.02	57.5	0	62.5	0
8	61.5	0.05	57.5	0	63	0
9	67.5	1.00	63	0	60	0
10	63.5	0	66.5	0	53	0.02
11	72.5	0.09	67	0	35.5	0.01
12	66.5	0	54.5	0	38	0.30
13	57	0	44.5	0	45	0
14	59	0	46	0.19	43.5	0.01
15	61.5	0	62.5	0.36	44.5	0.50
16	59	0	58.5	0.02	41	0
17	60	0	64	0	42	0.01
18	65.5	0.13	62	0.28	43	0.01
19	62	0	63	0.37	42	0.02
20	67	0	56.5	0	37	0.90
21	71	0	62.5	0	32	0.01
22	61	0	56.5	0	32.5	0.47
23	63.5	0.02	50	0	37	0.01
24	59.5	0	52.5	0	33	0
25	58	0	44	0	29.5	0
26	61	0	47.5	0.01	39	0
27	62.5	0.22	57	0	37.5	0
28	68	0	63	0	26.5	0.18
29	71	0	63	0	21	0
30	68.5	0.02	63	0	32.5	0
31	54.5	0.01	....	....	27.5	0

T = Trace, or less than 0.01 inch.
Mean = Maximum + Minimum ÷ 2.

TOTAL RAINFALL.

May	3.51
June	4.15
July	3.17
August	2.44
September	3.73
October	2.75
Total	19.75

1903.	May.		June.		July.	
Date.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.
1	35.5	0.25	55	0	58	0.03
2	38.5	0.10	55	T	58.5	0
3	42	0	60	0	58.5	0
4	51.5	0.20	61.5	0.09	53	0
5	40.5	0.04	66.5	0.73	48	0
6	34.5	0	60	0	55	0
7	33	0.09	70	0.52	60.5	0
8	31.5	0.08	66	0.23	68.5	0
9	39.5	0	58	0.10	67	T
10	40	0	54	0	60.5	0
11	42.5	0	45	0	61	0
12	61	0.02	46	0	69	0
13	44	0	53.5	0	68	0
14	47	0	55	0	68	0
15	62	0	61	0.15	65.5	0.06
16	64.5	0	60	0	61.5	0.05
17	68.5	0	58	0	57.5	0.18
18	63	0	65.5	0	60.5	0
19	44	0.02	68	0	62.5	0.10
20	39.5	0	64.5	0.73	69	0
21	42.5	0	59	0.02	72.5	0.46
22	58.5	0.04	53.5	T	68.5	0.49
23	47	0	57	0	54	0
24	48.5	0.02	57.5	0	62	0
25	51	0	60.5	0	65	0
26	38.5	0.57	62	0.03	66.5	0.15
27	40	0	62.5	0.03	63	0.14
28	40	0	67.5	0.45	62.5	0
29	44	0	72	1.20	65.5	0
30	48.5	0.18	63.5	0.10	61.5	0
31	60	0.02	....	....	54	0

1905.	August.		September.		October.	
Date.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.	Mean temperature.	Precipitation.
1	58.5	0	48.5	0.12	52	0
2	69.5	0	66	0.30	51	0
3	74	0.87	56.5	0	62.5	0
4	66	0.03	52	0	56.5	0
5	59	0.94	65	0	55	0.09
6	64.5	0	65	0	42	0.14
7	64	0	68	0	40.5	0.10
8	62.5	0	76.5	0	42.5	0.35
9	64.5	0.09	73	0	36.5	0.35
10	67.5	0	71.5	0	28.5	0.20
11	62	0	70	0.95	28	0.25
12	51.5	0	59.5	0.54	31.5	0
13	64.5	0	54	0.25	53	0
14	69	0	48.5	0	60	0
15	70.5	0	53.5	0	54.5	0
16	69.5	0.53	64	0.22	58	0
17	71.5	0.04	62	0.07	55.5	0
18	69.5	0	61	0	57.5	0.59
19	70.5	0	57.5	0	50	0.37
20	77.5	0.09	59	0	37.5	0
21	65.5	0.15	56	0.17	42	0.32
22	59	0.17	58	0.15	39.5	0.08
23	58.5	0.60	47	0	37.5	0
24	61.5	0	48.5	0	41.5	0.62
25	67.5	0.08	61	0	41	0.27
26	65	0.04	57	0	45	0.10
27	53.5	0	48.5	0	40	0.16
28	57.5	0	47.5	0	31	0
29	62.5	0.50	51.5	0	25	0.05
30	53	0	46	0	28.5	0
31	48	0	....	....	31.5	0

TOTAL RAINFALL.

May	1.63
June	4.38
July	1.66
August	4.13
September	2.77
October	4.04
Total	18.61

FIELD CROPS—CEREALS IN 1905.

While germination was slower than usual, the stand of all varieties was satisfactory and the more normal rainfall helped to check the damage from rust. The grain aphis was scattered and no other insect preying upon cereals has been found upon any variety.

Oats.—The rainfall during June was favorable to the development of rust and oats were damaged more than other cereals. The experiments of the past season emphasize the fact that for a variety to be rust-proof it must be early. The Early Champion ripened first and was practically free from rust. The Kherson ripened next and was nearly so, all the other varieties being damaged more or less. It was noted also that the earlier varieties of oats had the thinner hulls and are more susceptible to oat smut. Such varieties, therefore, will hereafter be treated for smut, while the later sorts will be left untreated. The Early Champion again leads in yield as it did during the previous season.

Kherson stands next and will prove to be a valuable variety. The straw is still shorter, but the spreading panicles are abundantly supplied with small berries which are pale yellow in color and have a thin hull. The seed was badly mixed with other varieties, and in order to obtain purer seed for further propagation, the plot was gone over several times and the plants of foreign varieties destroyed. The tramping of the plot thus reduced its yield. The somewhat lower ground of the Swedish and University plots gave clover a decided advantage, and the poor yields of the plots was largely due to the aggressiveness of the clover plants. The yields of the varieties are shown in the following table. All plots were 1x8 rods.

Varieties.	Time of planting.	Headed out.	Time of harvesting.	Length of straw inches.	Yield of plots in lbs.		Yield per acre.	
					Grain.	Straw.	Grain bushels.	Straw lbs.
Early Champion	April 27	July 5	Aug. 16	44	76	99	47½	1,980
Kherson	" 27	" 8	" 21	42	64	84	40	1,680
Golden Rust Proof	May 11	" 14	Sept. 5	47	36	119	22½	2,380
Red Rust Proof	" 11	" 15	" 5	47	35	98	21⅝	1,960
Imp. Prize Cluster	April 27	" 16	Aug. 29	54	58	145	36¼	2,900
Duppauer	" 27	" 20	Sept. 5	56	48	118	30	2,360
European Hulless	May 6	" 17	Aug. 30	52	28	180	17½	3,600
Swedish or Wisconsin No. 4	April 27	" 13	" 30	52	39	144	24⅜	2,880
American Banner	" 27	" 17	" 31	49	40	101½	25	2,030
Black Beauty	" 27	" 17	" 31	50	51	112	31⅞	2,240
University No. 6	" 27	" 15	" 29	51	36	118	22½	2,360

Cereals in 1906.—The low yield of the varieties was due to the fact that the ground had been mostly plowed during spring and that April and May were the two dryest months since work was first begun in 1900. If a roller which was subsequently secured, had arrived in time, it is more than probable that the packing of the soil would have largely counteracted the bad effects from late plowing and from the dry weather.

Oats.—Rust developed mostly during the wet weather in August, hence the damage as during previous seasons, was principally confined to the late varieties. The early varieties were treated for smut with formalin kindly donated by the manufacturer, the Pioneer Furnace Co., of Marquette. The treatment had the desired effect, for upon the whole number of plots, only three diseased stalks could be found during the entire season.

Seed of what will no doubt prove to be some very valuable varieties for this region, was kindly donated by Prof. John S. Cole, of the South Dakota Experiment Station. Under more favorable conditions and when planted earlier, Burt and Sixty Day, two white varieties, will no doubt measure up with the early varieties thus far introduced. North Finnish, a black oat, will probably prove to be the most valuable of these, judging at least from its satisfactory yield under adverse conditions and from the fact that the straw was bright and stout and the growth rank and healthy. The seed contained a large percentage of hybridized kernels, and these were sorted out and planted separate as

"North Finnish Hybrid." The seed of Great Northern, tested here for the first time, was secured from Chippewa county, where this variety is largely planted, it being claimed in some localities, that it does not rust, while in others it is said to rust occasionally. Here, the variety was damaged by rust worse than any other, though the plot was at a disadvantage, being shaded on the west side by the standing timber. The variety is a "side" oats, hence ripens late like all those which belong to this class, and it will be strange if further trials will show this to be an exception to the general rule which applies to the so-called immunity from rust.

Oats in 1906.

Varieties.	Size of plots.	Time of planting.	Headed out.	Time of harvesting.	Length of straw inches.	Yield of plots.		Yield per acre.	
						Grain lbs.	Straw lbs.	Grain bushels.	Straw lbs.
Great Northern	1-16 acre.	April 30	July 22	Sept. 10	44	56	133	28	2,128
Duppauer	1-20 "	" 27	" 17	Aug. 29	50	43	126	26⅝	2,520
American Banner	1-20 "	" 27	" 16	" 29	42	42	118	26¼	2,360
Improved Prize Cluster	1-20 "	" 27	" 15	" 28	45	33	134	20⅝	2,680
Kherson	1-16 "	" 27	" 6	" 15	40	68	105	34	1,680
Red Rust Proof	1-16 "	" 27	" 11	" 29	42	72	143	36	2,288
Early Champion	1-16 "	" 27	" 2	" 11	44	56	114	28	1,824
Swedish or Wisconsin No. 4	1-16 "	" 27	" 15	" 15	42	48	112	24	1,792
Golden Rust Proof	1-16 "	" 27	" 15	" 17	44	62	127	31	2,032
Early Mountain	1-20 "	May 8	" 20	" 30	39	30	127	18¾	2,540
Black Beauty	1-20 "	April 28	" 27	Sept. 4	49	40	112	25	2,240
University	1-20 "	" 28	" 17	Aug. 24	47	36	104	22½	2,080
Burt	1-32 "	May 8	June 30	" 9	40	18	48	18	1,536
Sixty Day No. 17720	1-32 "	" 8	July 5	" 10	34	29	46	29	1,472
North Finnish Hybrid	525 sq. ft.	" 12	" 11	" 17	50	19	47	48	3,899
North Finnish Carleton's C. I. No. 174, S. P. I. No. 5,513	375 sq. ft.	" 12	" 11	" 17	50	16	40	58	4,646

BARLEY AND SPELT.

The rank growth of clover, which was planted with the barleys and other cereals, was most conspicuous among the beardless varieties which, owing to their weaker straw, became lodged more or less during heavy wind-storms and thereby gave clover a further advantage. To this is due the poorer yield of these varieties. The continued low yields of French Chevalier will make the further test of this variety hardly advisable. This, as all other old-fashioned, two-rowed varieties, will not likely be able to compete any longer with the newer six-rowed varieties. No new varieties were tested, and the size of all plots was 1x8 rods, the yields being as follows:

Varieties.	Time of planting.	Headed out.	Time of harvesting.	Height of straw inches.	Yield of plots.		Yield per acre.	
					Grain lbs.	Straw lbs.	Grain bushels.	Straw lbs.
Mansheuri 6 rowed (Bearded).........	May 6..	July 7..	Aug. 16..	38	86	108	35	2,160
University No. 105 (Bearded)..........	" 9..	" 8..	" 16..	36	75	107	31¼	2,140
French Chevalier 2 rowed (Bearded)....	" 11	" 15..	" 24..	34	36	119	15	2,380
Chevalier (Beardless)................	" 11..	" 4..	" 22..	38	44	83	18⅓	1,660
Champion (Beardless)................	" 6..	" 3..	" 14..	45	58	101	24⅛	2,020
Success (Beardless)..................	" 6..	" 1..	" 14..	35	48	76	20	1,520
White Hulless (Hulless)...............	" 9..	" 8..	" 22..	36	28	172	11⅔	3,440
Spelt or Emmer......................	" 9..	" 17..	" 30..	46	62	126	51⅔	2,520

Barley and Spelt in 1906.—The beardless varieties were more seriously damaged than the others by the frost of May 20, all varieties being 4 to 10 inches high at that time. The fact that unseasonable frosts frequently work "in streaks" led to the assumption that the plot of Manscheuri was damaged from the same cause worse than the others, and only when the damaged portion was seen to extend gradually and had assumed the shape of an irregular crescent which covered about one-quarter of the plot, was it found that the plants were being rapidly destroyed by cut-worms which were found to be unusually numerous. A great many of the insects were killed with poisoned bait which, at first, consisted of imperfectly plowed under plants of Kale dipped in a light syrup and heavily sprinkled over with Paris green. For several days thereafter, as many as 57 dead worms were found under a single poisoned plant. A small quantity of seed of Sisolk No. 89 was kindly donated by the McPherson Kansas Experiment Station. This is a bearded variety whose fine growth and bright, heavy straw show it to be a valuable acquisition for this region.

Barley and Spelt, 1906.

Varieties.	Size of plots.	When planted.	Headed out.	Time of harvesting.	Length of straw inches.	Yield of plots.		Yield per acre.	
						Grain lbs.	Straw lbs.	Grain bushels.	Straw lbs.
University No. 105........	1-16 acre.	April 27..	July 6..	Aug. 20..	43	64	85	21⅓	1,360
Manscheuri...............	1-16 "	" 30..	" 6..	" 20..	41	54	88	18	1,408
Champion (Beardless)......	1-20 "	May 8..	" 2..	" 11..	39	38	87	15	1,740
Success (Beardless)........	1-20 "	" 8..	June 30..	" 9..	37	20	32	8⅓	640
Sisolk No. 89..............	168 sq. ft.	" 10..	July 8..	" 15..	41	6¼	11¼	35	2,981
Spelt or Emmer...........	1-20 acre.	April 28..	" 16..	Sept. 7..	42	39	182	32½	3,640

Wheat in 1905.—The Velvet Don is a variety, the seed of which was kindly donated by the South Dakota Experiment Station. It is a durum or macaroni variety, which, during the first trial, has given better results than any similar variety heretofore tested. The origin of the macaroni wheat indicates that they are adapted to localities where the rainfall is at least a third less than in this region. It is probable, therefore, that even should the yield be satisfactory, the varieties would

degenerate into soft wheat under the influence of a greater amount of moisture.

The winter wheat varieties were planted upon rather low ground south of the creek, the plots having been used for strawberries for several years and the ground having been partially drained since then. Portions of the plots were still too wet, though no rust was observed until the beginning of August, when a severe attack caused the premature ripening of the grain upon the wettest portions. Upon the high and well-drained ground north of the creek, one plot was practically destroyed from apparently the same cause as that which was reported during the past season. Some extensive experiments were started late in the season for the purpose of ascertaining the true cause. The yield of the several varieties is set forth in the following table.

Varieties.	Size of plots.	Time of planting.	Headed out.	Time of harvesting.	Height of straw inches.	Yield of plots.		Yield per acre.	
						Grain lbs.	Straw lbs.	Grain bushels.	Straw lbs.
Dawson or Golden Chaff (Winter)	1-5 acre.	Aug. 18	June 29	Aug. 15	61	428	1,172	35⅔	5,860
International No. 6 (Winter)	¼ "	" 18	" 30	" 14	57	474	1,012	31	4,048
Velvet Don (Macaroni)	1-60 "	May 11	July 12	" 28	44	19	57	19	3,420
Minnesota No. 163 (Spring)	1-20 "	" 6	" 17	Sept. 5	47	55	125	18⅓	2,500
Velvet Chaff (Spring)	1-20 "	" 6	" 20	" 7	50	57	142	19	2,840
Saskatchewan Fife (Spring)	1-20 "	" 9	" 18	" 7	49	45	134	15	2,680

Wheat in 1906.—Of the two varieties tested for the first time, Umillio is said to be the hardiest of the Durum or Macaroni varieties. The seed was kindly donated by the South Dakota Experiment Station, and the milling quality of the wheat is said to be very poor. Kharkoo No. 9125 is a bearded red wheat recently imported from the Russian province of that name by the U. S. Department of Agriculture which furnished the seed. While the yield was not large, the quality of the wheat is excellent. The yield of the spring varietis is shown in the following table:

Varieties.	Size of plots.	Length of straw inches.	Time of planting.	Headed out.	Time of harvesting.	Yield of plots.		Yield per acre.	
						Grain lbs.	Straw lbs.	Grain bushels.	Straw lbs.
Minnesota 163	1-20 acre.	42	May 8	July 14	Sept. 3	48	157	16	3,140
Saskatchewan Fife	1-16 "	44	" 8	" 13	" 3	45	145	15	2,900
Velvet Chaff	1-20 "	44	" 8	" 17	" 3	51	160	17	3,200
Velvet Don	1-20 "	44	" 8	" 13	Aug. 28	30	78	10	1,560
Umillio	989 sq. ft.	40	" 9	" 11	" 29	15	40	11	1,761

Winter Wheat Experiments During 1906.—The plants which were killed during the preceding two seasons were apparently healthy at the beginning of winter. Here and there the lower leaves of some of the plants were pale green or yellow, but as these were few and were invariably found in depressions where the water from late rains and

from the early snow flurries had accumulated more or less, the cause of this was attributed to standing water.

Winter killing, in the sense of which it occurs in regions farther south where the absence or scarcity of snow causes the alternate freezing and thawing of the ground, was left out of consideration, since here the ground does not freeze. The opinion heretofore advanced that the plants might have been killed by a lack of air due to the formation of snow crusts, was less the expression of a belief than that of a popular and as yet unchallenged notion that a great depth of snow is apt to "smother" the wheat. In connection with this, the thought suggested itself that this so-called smothering might be due, partly at least, to an interception of light, and not merely of air. These and the other questions which were deemed necessary for consideration were, first, the proper time of planting in order to determine whether plants which had reached a certain stage of development might be injured more or less than others before the beginning of winter; second, the manner of planting, in order to determine whether plants from seed which had been broadcasted and whose roots are probably closer to the surface, might be injured more than seed which had been drilled in; third, a variety test in order to determine whether one variety is subject to injury more than another; fourth, a soil test in order to determine whether plants on ground upon which no wheat has heretofore grown, are injured less than others in case the injury should prove to be due to a fungus. In addition to this, it was deemed advisable to use different quantities of seed for some of the plots, it being assumed that if an equal amount of injury should result the heavier seeding might still have a satisfactory stand.

Eight plots were laid out on old ground upon which wheat had grown once or twice during the preceding five years. This ground has a steep slope towards the south and thereby affords a better opportunity for the formation of snow crusts. Eleven plots were laid out on new ground which had been cleared early in the season. This ground has an equally steep slope facing the north, hence affords the minimum opportunity for the formation of snow crusts. For the purpose of observing the effect from the interception of light as well as for preventing the formation of snow crusts, a space six feet square was covered upon two different plots with heavy tar paper, and this with matched lumber, at the time when the snow was 18 inches deep and before any crusts had formed. The ordinary seeding was done at the rate of eight pecks per acre, the heavy seeding at the rate of ten and the light seeding at the rate of seven, while the drilled seed was used at the rate of six pecks per acre. The first planting was done August 19, the second August 30 and 31, and the third September 15, 16 and 18. Five varieties, as shown in the following table, were used for these experiments, and owing to a lack of available ground only the Dawson variety was used for the entire series. During late fall the stand of all plots ranged from fair to perfect, the poorest being one of the Dawson plots where quack grass had been abundant at the time the ground was plowed at the beginning of August.

From January until the end of March, observations were frequently taken for the U. S. Weather Bureau for the purpose of ascertaining the water content of snow at each inch of depth, and this afforded an oppor-

tunity of studying the behavior and note the number of snow crusts. It was found that there was a constant melting of snow at the bottom regardless of the temperature of the air; that nine distinct crusts had formed during the warm winter days, and that the crusts rapidly disintegrated as they came nearer the surface of the ground, becoming honey-combed at first, until when within about a foot of the ground there was nothing left to show their former presence except a yellowish-colored horizontal streak.

That the snow at the bottom melts quite constantly was further demonstrated by another series of observations taken at the same time with a galvanometer of Prof. Curtiss of the Michigan Agricultural College, these observations showing that the temperature at the surface of the ground remains quite constant during the winter and ranges from slightly below to a little above 32° Fahrenheit. These observations show that the plants are not likely to be damaged to any great extent, much less killed, either by cold temperatures or by the interception of air circulation, and that the theory of "smothering," whatever it may be elsewhere, does not apply here. It was assumed that if the plants are killed by a fungus which is capable of propagating under the snow, the time of planting might be the most important question involved, and the following tables of yields is arranged accordingly. When the snow had all disappeared during spring, all the plots were found to be damaged to some extent. The injured portions consisted either of long, narrow strips which followed the slope of the ground, or of solid patches which were irregular to nearly round in shape. No crusts had formed under the tar paper and boards which had been used for covering a portion of two plots. Under this covering the snow was still four inches deep when it had completely disappeared elsewhere, but there was nothing to indicate either then or subsequently that the covering had affected the plants either one way or another. The damaged portions of the plants dried up within a few days after the snow had disappeared and their surface was found covered with numerous sclerotium or fruit bodies of a fungus whose name or nature could not be ascertained. The active stage of what was either the same or another fungus and which was bright red colored, was found at the same time on two plots but only upon three or four plants which were still healthy. The yields of the plots are shown in the following table:

Varieties.	Seed used per acre. Pecks.	Where planted	Size of plots. Rods.	Yield of plots. Grain lbs.	Yield of plots. Straw lbs.	Yield per acre. Grain bushels.	Yield per acre. Straw lbs.
Planted August 19.							
Russian	8	New ground	1x10	67	232	17.86	3,712
Jones Longberry	8	New "	1x10	44	148	11.73	2.368
Kharkov	8	New "	1x10	45	209	12	3.344
Kharkov	8	Old "	1x5	27	115	14⅖	3,680
Inter. No. 6	8	New "	1x5	30	95	16	3,040
Dawson	8	New "	1x16	93	472	15½	4,720
Dawson	8	Old "	1x6	21	78	9⅓	2,080
Planted August 30 and 31.							
Kharkov	8	New ground	1x10	55	185	14⅔	2,960
Kharkov	8	Old "	1x6	21	48	9⅓	1,280
Dawson	8	New "	1x10	96	196	25⅗	3,136
Dawson	8	Old "	1x6	39	99	17⅓	2,640
Planted September 15, 16, 18.							
Inter. No. 6	7	New ground	1x10	27	70	7	1,120
Inter. No. 6	7	Old "	1x8	28	84	9⅓	1,680
Dawson (Drilled)	6	New "	1x5	26	65	13.86	2,080
Dawson	7	New "	1x5	30	80	16	2,560
Dawson	10	New "	1x10	63	151	16	2,416
Dawson (Drilled)	6	Old "	1x4	12	36	8	1,440
Dawson	7	Old "	1x4	24	48	16	1,920
Dawson	8	Old "	1x8	56	132	18⅔	2,640

Analyzing the results and assuming that a yield of ten bushels or less per acre is a failure, the table does not show that the damage is related to the time of planting, for there was one failure in the first, one in the second and three in the third planting. Neither does it show that old ground is accountable for it, even though the failures on such ground were four times greater than on new ground. Nor does it show that the damage is related to the question of variety, for there was one failure with Kharkov, two with Inter. No. 6, two with Dawson, and it is safe to assume that there would have been some with the other two varieties had it been possible to make several plantings with each. The same applies to the manner of planting and to the amount of seed used per acre, for even though only two plots were drilled, there was a failure with one, while the heavy seeding gave two failures, and two plots of Dawson and one of Russian for which eight pecks of seed were used gave a larger yield than the Dawson plot for which ten pecks were used.

During the fall of 1906 the most important of these experiments were repeated, and five plots were found to be affected more or less by yellow rust at the beginning of November.

Field Peas in 1905.—While the vines of the larger varieties reached the usual length of 10 feet or more, the dryer weather enabled them to ripen better and the curing was correspondingly easier. During this, the second test, French June, owing to the shorter vines, again leads all others. *Black English*, a variety tested for the first time, comes next, is also next in length of vines, and will prove to be a valuable variety for stock. While blossoming late, the pods ripen quickly, being

ready for harvest practically as early as French June. The peas are of medium size, crowded in the pods, hence flattened, the color being a yellowish pale green with numerous minute black dots. *Spanish Field Peas*, also tested for the first time, proved to be a variety of Lathyrus, and therefore not a field pea. The planting was done still later, May 24, but as some of the pods ripened, the variety may be of some value. The following table gives the yield of the other varieties; all plots being 1x8 rods.

Varieties.	Time of planting.	Time of blossoming.	Time of harvesting.	Length of vines inches.	Yield of plots.		Yield per acre.	
					Grain lbs.	Straw lbs.	Grain bushels.	Straw lbs.
French June	April 27	July 5	Aug. 28	62	123	149	41	2,980
Black English	" 27	" 13	" 29	66	115	144	38⅓	2,880
Canada Beauty	" 27	" 12	Sept. 5	120	99	114	33	2,280
Victoria	" 27	" 11	" 14	118	63	135	21	2,700
Scotch	" 27	" 16	" 8	110	77	141	25⅔	2,820
Canadian Blue	" 27	" 12	" 8	104	87	116	29	2,320
Egyptian Mummy	" 27	" 10	Aug. 31	102	54	95	18	1,900
Black Eyed Marrowfat	" 27	" 9	" 31	108	51½	87	17⅛	1,740
Imp. Prussian Blue	" 27	" 12	" 30	96	57	83	19	1,660

Field Peas in 1906.—Though the yield of nearly all varieties was satisfactory, the hot and dry weather during July was very unfavorable for this crop, and perhaps for this reason, a fungus, probably the Powdery Mildew [Erysiphe Communis (Wall.) Fr.], was observed for the first time. Only a very few vines of the French June variety were affected by it. *Scotch Grey* belongs to the Black English type of peas, being merely lighter colored. Both are coarse and poor-flavored, but are quick and even-ripening varieties which are well adapted for stock. The yields are shown in the following table:

Field Peas in 1906.

Varieties.	Size of plots.	Time of planting.	Time of blossoming	Time of harvesting.	Length of vines inches.	Yield of plots.		Yield per acre.	
						Grain lbs.	Straw lbs.	Grain bushels.	Straw lbs.
Canadian Blue	1-16 acre	April 25	July 9	Aug. 24	86	90	139	24	2,224
French June	1-20 "	" 25	" 1	" 10	64	68	132	22⅔	2,640
Prussian Blue	1-16 "	" 25	" 10	" 24	94	110	131	29⅓	2,096
Black Eyed Marrowfat	1-16 "	" 27	" 9	" 28	104	105	140	28	2,260
Scotch Grey	1-16 "	" 27	" 11	" 28	68	84	147	22⅖	2,352
Scotch	1-16 "	" 27	" 13	" 28	106	92	132	24½	2,112
Egyptian Mummy	1-16 "	" 27	" 9	" 30	102	90	134	24	2,144
Canadian Beauty	1-16 "	" 27	" 7	Sept. 1	120	75	134	20	2,144
Victoria	1-20 "	" 27	" 6	" 1	120	39	95	13	1,900
Black English	1-32 "	May 8	" 12	" 1	68	63	73	33⅗	2,336

CORN IN 1905.

Several varieties ripened perfectly and the ears of all others reached the glazing stage or soft corn. The successful results are undoubtedly due to earlier planting, the absence of spring frosts or the selection of varieties which, during the preceding season, seemed well adapted to this region.

Four varieties, namely the Jehu, Will's Dakota, Dakota Sunshine and Golden Dent, were planted on three plots in a series of experiments to determine the influence of manure upon the temperature of the soil. The yields of the four varieties upon the three plots were as shown in the next table.

Varieties.	Plot 1. Clover and manure.			Plot 2. Manure.			Plot 3. Nothing.		
	Yield of plot. Lbs. of ears.	Yield per acre. Bushels.	Market condition.	Yield of plot. Lbs. of ears.	Yield per acre. Bushels.	Market condition.	Yield of plot. Lbs. of ears.	Yield per acre. Bushels.	Market condition.
Gehu	18	31.82	95	16	28.28	95	12½	22.09	90
Will's Dakota	16	28.28	92	14	24.75	90	10	17.67	85
Dakota Sunshine	19	33.58	80	15	26.51	80	10	17.67	75
Golden Dent	19½	34.47	90	16	28.28	90	11	19.44	80

Varieties, the seed of which was furnished by the U. S. Dept. of Agriculture, were tested upon plots which gave rather poor results, owing to the shade from the adjoining timber on the west side and within four rods of the plots. One row of each variety was planted, the row consisting of 20 hills which were thinned out to three stalks for each hill, and the rows and hills being 4 feet apart. More or less ears from each variety were rejected for being soft when weighed September 25, the yields in the following table being those of well ripened ears only. All varieties were planted May 25, except Triumph, which was planted May 28:

Variety.	Color.	Date of tasseling.	Date of silking.	Height of stalk. Inches.	Length of ears. Inches.	Number of rows of kernels. Per ear.	Market condition. per cent. 0 to 100.	Yield of plot. Lbs.	Yield per acre. Bushels.
Early Tuscarora	White Flint	Aug. 2	Aug. 15	61	7½	8	80	4½	8.75
North Dakota	White Flint	July 28	" 10	76	7	8	90	6½	12.63
Northwestern	Red Dent	" 29	" 8	78	7¼	10-14	85	14	27.12
Triumph	Yellow Flint	Aug. 9	" 21	76	7	10-12	75	9	17.50
Minnesota No. 13	Yellow Dent	" 12	" 23	78	6½	12-16	75	8	14.70
Sterling	Yellow Flint	" 17	" 30	96	7½	10-12	70	10	19.44
Rustler	White Dent	" 14	" 21	90	7	10-12	65	4	7.77
Ninety Day	Yellow Flint	" 10	" 22	76	8	8	70	11	21.39
Moore's Premium	Yellow Flint	" 10	" 20	84	8½	8	70	6½	12.63
Rhode Island	White Flint	" 9	" 16	66	6½	8	65	6	11.66
Golden Ideal	Yellow Dent	" 18	" 25	98	6¾	14-20	70	7	13.61

It is not likely that any of the foregoing varieties, even had they been planted in a more favorable location, would have proved superior, or even equal to the four varieties in the next preceding table, though the Northwestern and the North Dakota would have probably ripened as well as Dakota Sunshine. The tests of this and preceding season clearly indicate that until varieties have become acclimated or bred under conditions of moisture and temperature which obtain in the Upper Peninsula, the safest varieties to begin with are those which have originated or have been acclimated in North Dakota. Early Adams is the next safest variety, and this no doubt because the variety has become quite cosmopolitan, being used in many states as an inferior sort of table corn. Gehu as a flint and Golden Dent as a dent variety may well be considered the most reliable for the beginner who thereafter has it in his own hands to hasten the process of acclimation by constant selection in which the question of earliness must be rigidly applied. Varieties which have already ripened in the Upper Peninsula would, of course, be much better, and four of these have been found after diligent inquiries and personal investigations during the past five years. Unfortunately there is little if any seed available, for they have been grown merely in small patches, and although they have ripened continuously regardless of seasons, the owners still raise them as a matter of curiosity rather than of economy. All of these four are flint varieties, either white or straw color, and during a personal visit one or two ears from each have been secured, namely from Martin Heim who states that he has ripened the variety during the past 13 years in Alger county, J. R. Ryan, who has ripened one in Chippewa county during the past 17 years, stating that he obtained the original seed from Wm. Greenough, one of the oldest settlers, who secured it from the Indians in the northern part of the county, where it had ripened previously for 30 years or more. The third variety was secured from Ira Carley, who has ripened it in Menominee county during the past nine years, while the fourth was obtained from John Barron, who has ripened it in Delta county during the past 21 years. The difference in moisture, if not in temperature conditions, suggests that the future type of Upper Peninsula corn will differ from the North Dakota type, and with the material now on hand, it is hoped that valuable results may be obtained from breeding experiments which will be started during the next season.

In addition to the varieties described, Extra Early Adams was tested during the past season, 20 hills 4 feet apart being planted May 25 and giving a yield of 11½ pounds of well-ripened ears, or at the rate of 22.36 bushels per acre.

As a variety better adapted to localities with extensive clearings, such as are found in Delta and Menominee counties, and especially for the purpose of siloing, Dakota Sunshine, recently originated in North Dakota, may be highly recommended. The stalks average 8 feet high or better, generally carry two very large ears 7½ inches long with 12-18 rows of kernels and broad leaves of more than average length.

One row of 20 hills 4 feet apart of Mercer, a yellow flint heretofore tested, was planted May 26. The row was upon a plot which had a small amount of strawy manure plowed under for the purpose of observing the effect of soil temperature upon field beans. The ears were har-

vested October 15 or 4 days after what is termed a killing frost had occurred. The field notes show that the stalks and two-thirds of the leaves showed no effect from the frost, that 75 per cent of the ears were ripe and the kernels of the others well glazed and hard. The total yield gave 20 pounds of which 25 per cent, or 5 pounds, were rejected, leaving 15 pounds as the yield of the plot, or at the rate of 29.17 bushels per acre.

Corn in 1906.--The weather conditions, especially at about ripening time during the forepart of September, were more favorable for corn than during any preceding season. All varieties ripened well, though there was more or less soft corn from such late varieties, as Ninety Day, Rustler, Golden Ideal and Minnesota 13.

The seed of one of the most valuable varieties which have been tested so far, was kindly donated by M. S. Joiner of Benzonia (Mich.) who stated that for a number of years he had been selecting the earliest ripe ears for seed, but forgot the name of the variety. The ears showed that the variety has ripened in the immediate neighborhood of some white Dent, but those with red cobs and a color nearly uniform resemble the Golden Dent with the ears somewhat longer, the color a deeper golden yellow, and during this first test ripened at about the same time with two ears to each stalk. The name "Joiner" will be used hereafter for this variety.

The fertilizer experiment with coarse manure and clover seed was continued. In this test a minimum amount of both was used, and the deficiency was supplemented by adding a commercial fertilizer at the rate of 800 pounds per acre. The amount of manure was probably less than two tons per acre, for there was not enough to completely cover the ground when spread out thin. The clover and manure plot was fully three-quarters grass sod, for the plot had been planted with Alsike clover in May, 1902, and most of the clover plants have been gradually run out since. The clover plot had been planted with crimson clover during the preceding season, hence there was no sod left when the plot was plowed during the following spring, nor have any nodules ever been found here upon the roots of crimson clover. The commercial fertilizer contained no filler and was composed of 185 pounds dried blood, 150 pounds Michigan Carbon Works precipitated phosphate and 100 pounds sulphate of potash. It therefore contained 5.1 per cent nitrogen, 10.34 per cent phosphoric acid mostly available and 11.5 per cent potash. One-half of the fertilizer was applied at planting time, and the other half when the corn was about four inches high. For the purpose of better observing its effect, it was applied on one-half of each plot only. The plowing, as during the past season, was done during late spring, and the planting was done May 25 in hills 4 feet apart each way. Either owing to the smaller amount of the plowed under coarse material or to the dry weather of the forepart of the season which no doubt retarded the decomposition of the sod and manure, the difference in the time of tasseling, silking and ripening was much less than during the past season. At no time during the entire season was it possible to observe the slightest difference between the half plots which received the commercial fertilizer and the other halves which received none. There was a very slight difference on the plot where nothing was plowed under, but this was so small and so far from being uniform that it was at-

tributed to inequalities of the soil. In this test *Square Deal,* a yellow dent, was used instead of Golden Dent. This variety has been recently originated in North Dakota and is claimed to be the earliest dent corn known. The ears are medium size, mostly two to each stalk and ripened fairly well, but the claim was not substantiated. The ears of these and all other varieties tested during the season were kept in open crates on a well-ventilated barn floor until the last week in November, when they were weighed and 70 pounds were taken to represent a bushel of shelled corn. The yields are shown in the following table:

Varieties.	Plot 1. Clover. (96 hills.)		Plot 2. Clover and manure. (100 hills.)		Plot 3. Manure. (64 hills.)		Plot 4. Nothing. (64 hills.)	
	Yield of plot. Lbs. of ears.	Yield per acre, bushels of shelled corn.	Yield of plot. Lbs. of ears.	Yield per acre, bushels of shelled corn.	Yield of plot. Lbs. of ears.	Yield per acre, bushels of shelled corn.	Yield of plot. Lbs. of ears.	Yield per acre, bushels of shelled corn.
Gehu	30	48.61	30	46.67	19	46.18	18	43.75
Will's Dakota	32	51.85	33½	52.11	20	48.61	18½	44.96
Square Deal	26	42.13	26½	41.22	16	38.89	16	38.89
Sunshine	27	43.75	28½	44.33	17	41.32	16	38.89

The varieties tested for the U. S. Department of Agriculture were the same as those which were tested during the past season and the results are given in the following table:

Varieties.	Color.	Date of tasseling.	Date of silking.	Height of stalks. Inches.	Length of ears. Inches.	Number of rows of kernels Per ear.	Market condition. Per cent. 0 to 100.	Yield of plot. Lbs.	Yield per acre bushels of shelled corn.
Gehu	Yellow Flint	July 24	Aug. 1	60	7	8-12	95	12	38.89
Early Tuscarora	White Flint	" 26	" 5	72	7½	8	92	20	64.82
Rhode Island	White Flint	" 31	" 9	84	8	8	88	18	58.33
No. Dakota Golden Dent	Yellow Dent	" 27	" 4	78	7	12-16	92	18¾	60.77
No. Dakota White Flint	White Flint	" 26	" 4	66	7	8	96	12½	40.51
Northwestern	Red Dent	" 31	" 6	78	7½	10-14	92	21	68.06
Triumph	Yellow Flint	" 31	" 9	96	7½	10-12	88	14	45.37
Minnesota 13	Yellow Dent	Aug. 2	" 9	95	7	12-16	85	14½	46.99
Ninety Day	Yellow Flint	" 8	" 17	102	8½	8	80	14½	46.99
Moore's Premium	Yellow Flint	" 1	" 10	96	8	8	88	16	51.85
Rustler	White Dent	" 8	" 14	102	7	12-16	70	9½	30.79
Sunshine	Yellow Dent	" 1	" 8	90	7½	12-16	85	13	42.13
Golden Ideal	Yellow Dent	" 11	" 16	108	7	14-20	72	10½	34.03

On the same day, or May 26, there was also planted alongside the N. D. Golden Dent and of Sunshine an equal number of hills from seed which ripened here in 1905. The noteworthy features were earlier tasseling and silking by from one to four days. From the home-grown seed the stalks of Golden Dent were six inches shorter and those of Sunshine 12 inches shorter. On the other hand both were ripe several days earlier and the yield of Golden Dent was 21½ pounds or 69.68

bushels per acre, while Sunshine gave 17 pounds or 55.09 bushels per acre.

Corn Breeding Experiment in 1906.—The flint varieties which were secured in 1905 and which have continuously ripened in different parts of the Upper Peninsula for a number of years, were used for a breeding test, whose purpose consists in developing a new and more desirable variety. While earliness will be considered all-important, it is expected that the new variety will be larger, both in stalks and ears, and that the stalks will be nearly if not entirely free from suckers. As this can best be accomplished by hybridization, the Golden Dent has been selected as the male parent, and the different varieties of flint were detassled. This was rendered the more necessary, because the Golden Dent is more nearly pure bred, while the flint varieties showed evidence of having ripened at some time or other in the vicinity of sweet and other varieties. Early in spring another variety was secured from Dickinson county, where it has ripened for several years. As this is a strain of the colored flint known as Squaw, it has been used under this name and only the yellow kernels were planted. The other varieties have been given the names of those who donated the seed, those used in the present test aside from the Squaw being therefore the "Ryan," "the Barron" and the "Heim." The planting was done May 28 in hills 4 feet each way, the rows of flint being alternated with rows of Golden Dent from seed which ripened here in 1905. On the east side of the plot three more rows of Golden Dent were planted with seed donated by the North Dakota Experiment Station, and the center row was detasseled for the purpose of securing seed for future work. On the other three sides and for the purpose of guarding more effectively against foreign pollen, two additional rows were planted with Golden Dent which had been ripened in 1905 by Ira Carley of Menominee county, and for further safety, the hills of the outside rows were planted two feet apart. There was little difference between the height of stalks from the home-grown and the North Dakota seed, but the home-grown seed was earlier in all respects to about the same extent as in the case already mentioned. The results from the Menominee county seed were very conspicuous throughout the season, for the stalks were 8 feet high as against 6½, and the ears were very much larger. On the other hand, they tasseled and silked August 2 and 7 respectively, as against July 26 and August 1, they ripened ten days later, and about one-fifth of the ears were more or less chaffy when weighed at the end of November.

These three instances afforded a striking example of how rapidly corn will adapt itself to new environments, and demonstrated the all-importance of breeding an Upper Peninsula type of corn which is sure to ripen in every locality regardless of seasons.

Each of the flint varieties occupied a space equal to 384 square feet, and the total space occupied by the Golden Dent was ten times larger, or 3,840 square feet. That the developing of an early variety may be expected with reasonable assurance was shown by the fact that 10 to 15 per cent of the ears from the "Ryan" and the "Heim" were dead ripe August 28. Out of over 100 so-called early varieties which have been tested heretofore, Gehu has proved to be the earliest and the safest, and the earliest ears equally as ripe were secured September 8, or 11

days later. It is but proper to add here that for work which means so much to this vast portion of the State, the station is sadly in need of a larger cleared area. With corn, the question of soil, is no less, and in fact is perhaps more important than the question of variety, and of the present cleared area the station has less than six acres whose soil is well adapted for corn. This area is ample for corn breeding experiments, but only on condition that the work with other varieties be abandoned, and it would be decidedly unfortunate if this should have to be done. The yields of the plot are shown in the following table:

Varieties.	Time of tasseling.	Time of silking.	Height of stalks. Inches.	Yield of plot. Lbs.	Yield per acre. Bushels.
Golden Dent	July 26	Aug. 1	78	320	$51\frac{4}{5}$
Barron	" 26	July 31	84	30	$48\frac{3}{5}$
Ryan	" 19	" 23	48	31	$50\frac{1}{4}$
Heim	" 23	" 26	48	$28\frac{1}{2}$	$46\frac{1}{6}$
Squaw	" 24	Aug. 1	54	$34\frac{1}{2}$	$55\frac{9}{10}$

Pop-corn.—Some seed of a dwarf and very early variety locally known as Tucket, was kindly donated by Judge L. C. Holden of Sault Ste. Marie. The stalks are two feet high, tasseled July 22, silked July 26 and the ears were ripe August 23. The kernels are deep yellow, and while very small they expand considerably when popped and are more tender than the large varieties.

A blue colored variety of much larger size was obtained from the same source. The stalks were 5 feet high, tasseled August 2, silked August 10 and the ears were ripe September 20. The bulk of the kernels when popped is nearly as large as that of the Rice variety, and the quality is somewhat better.

MISCELLANEOUS FIELD CROPS.

Field Beans in 1905.—A plot which had coarse manure plowed under was used for the Swedish Brown variety, the seed of which had previously ripened here. The beans were planted May 31, the intention being to use one-half upon an unmanured plot, but owing to a misunderstanding all the available seed was used upon the manured plot. It is still an open question, therefore, whether these beans which blossomed first, even though planted four days later than the others, did so for being an earlier variety rather than on account of the heat from the decomposing manure which induced a more rapid growth. Though the rows were two feet apart, the rank growing vines completely covered the ground soon after they started to blossom and held their leaves much longer than the other varieties, thus suggesting that although all the pods ripened evenly during this test, they might not do so under like conditions during less favorable seasons. The vines blossomed July 16 and were heavily loaded with pods when harvested during the latter part of September. Pressure of other work prevented threshing until the forepart of December, and the beans were in prime condition, having been kept on a well-ventilated floor. The plot which was 12x90 feet gave a

yield of 76 pounds, or at the rate of 51.08 bushels per acre. An extensive search for nodules upon the roots of this and all other varieties, failed to reveal their presence.

Improved Pea, a white bean of the Navy type, was planted May 27. The rows were 2 feet apart and the plot 8x100 feet. The vines blossomed July 18 and ripened September 15. The plot gave a yield of 32 pounds of choice beans, or at the rate of 29.04 bushels per acre.

Earliest Navy resembles the last and was planted May 27 in rows 2 feet apart. The vines blossomed July 19 and were ripe September 20. The plot which was 6x100 feet gave a yield of 23 pounds of beans of prime quality, or at the rate of 27.83 bushels per acre.

Buckwheat. Rye Buckwheat and Japanese, two varieties tested during the preceding season, were planted May 24 upon adjoining plots of 1x5 rods each. A light frost, at the time the varieties were in full blossom, partly damaged the Japanese variety but left no signs of damage upon the other plot. The damaged portion of the plot was in the shape of a "pocket" which afforded no escape for the cold air. As room was needed for other purposes, the Buckwheat was cut green and the plot fitted for winter wheat. The value of the test consists in emphasizing the necessity for early planting, early frosts, however light, being more damaging to this crop than late frosts of the severest kind while the plants are small. Struck by a so-called killing frost during the spring of 1903, while the plants were up with the true leaves just appearing, "none of the plants appeared to suffer from the damage and an even stand was secured." (Special Bulletin No. 28, Page 8.)

Rye Buckwheat blossomed July 13, was cut September 7 and yielded 66 pounds of grain and 87 pounds of straw; the amount being equal to a comparative yield of 44 bushels of grain and 2,784 pounds of straw per acre.

Hemp.—Stout and very thrifty plants were secured from seed kindly donated by the Kentucky Experiment Station, the seed being planted May 25. The plants did not blossom until August 28 and ripened very little seed probably owing to the shade from the nearby timber. They averaged 11 feet high when a photograph was taken August 24, and 13½ feet when some of the plants were sent to the State Fair in September,

Broom Corn or Hog Millet was planted for seed May 29 and was cut September 13. Approximately five per cent of the plants were destroyed by smut, this being the first time that this fungus has been seen here. While a considerable portion of the seed was harvested by sparrows, the plot which measured 1x6 rods gave a yield of 36 pounds of seed and 138 pounds of straw, or at the rate of 48 bushels of seed and 3,680 pounds of straw per acre.

MISCELLANEOUS FIELD CROPS IN 1906.

Field Beans in 1906.—The varieties tested are Swedish Brown, Earliest Navy and Isbell's Improved Pea, from seed which ripened here in 1905, and Great Northern, a white variety which is claimed to be earlier, but did not prove to be as early as either of the other three, the beans being larger and more flat shaped than those of the Navy type. Inasmuch as no nodules have ever been found upon the roots of the common beans, it was deemed of interest to use these varieties for an inoculating

test, the material for which was furnished by the U. S. Department of Agriculture, and appeared to be in good condition when used at planting time. Enough coarse manure to barely cover the ground was plowed under, and about fifty rods north of the plot an additional plot of Swedish Brown was planted without manure. Both plots were on sloping grounds, and the lower half was inoculated in order to prevent natural drainage from carrying some of the inoculating material upon any portion of uninoculated one-half. As a further preventative, a space two feet wide was left unplanted between the two halves, and whenever the plots were cultivated, the inoculated half was cultivated either the day before or after. No beans have ever grown upon the manured plot nor any upon the unmanured plot except two rows of garden beans in 1905, when each plant had been pulled up and found to be free from nodules. The manured plot was planted June 5, and the other on June 6. The season was fully as favorable for beans as the preceding one, except that cutworms destroyed fully 60 per cent of the inoculated half of the earliest Navy plot, and to this must be ascribed the low yield of this plot. The rest of the plot and the unmanured plot were saved by surrounding them with narrow strips of poisoned bran which had been moistened with molasses. At the time the plants on the unmanured plot were in full blossom, most of the leaves were attacked by a fungus which caused the outer edge to dry up and some of the leaves to drop off before the pods were ripe. It is quite certain therefore that the difference in yield between the two plots of Swedish Brown is due to this disease. From each plot about a dozen plants were pulled up and the roots examined during the last week in June and again just before the plants started to blossom. Almost every inoculated plant had numerous nodules in size about as large as small field peas, while a few uninoculated plants were found with less numerous nodules about as large as ordinary pinheads. Subsequent examinations showed that practically 25 per cent of all uninoculated plants were provided with nodules which had increased in size, but at no time became as large or as numerous as those upon the roots of inoculated plants. Nodules were also found for the first time upon the roots of approximately one-quarter of the plants of all garden varieties except the lima beans. The following table gives the yield of the plots:

Varieties.	Time of blossoming.	Size of plot. Square feet.	Yield of plot. Lbs.		Total yield of plot. Lbs.	Yield per acre. Bushels.
			Inoculated.	Not inoculated.		
Swedish Brown (not manured)	July 15	1,764	39½	40½	80	32.92
Swedish Brown (manured)	" 18	992	30	29	59	43.17
Earliest Navy (manured)	" 22	1,166	12½	30	42½	26.46
Isbell's Improved Pea (manured)	" 21	1,166	27½	26½	54	33.62
Great Northern (manured)	" 22	500	10½	12	22½	32.67

Buckwheat in 1906.—The variety Rye Buckwheat was planted May 31. It blossomed July 12 and was harvested August 24, the stand having

been materially reduced by cutworms. The size of the plot was 1-20 acre, and the yield was 62 pounds, or at the rate of 25 5-6 bushels per acre.

Flax was planted May 9, blossomed July 11 and was harvested September 25. One sixty-fourth acre gave 9 pounds of seed, or at the rate of 10 2-7 bushels per acre.

Hemp.—One row was planted with seed which had ripened here in 1905. The planting was done May 9, or much earlier than during former tests, and in order to enable the plants to branch out freely for seed-bearing purposes, the row was allowed eight feet in width and the plants were thinned out to about two feet. Former tests have demonstrated the hardiness of this crop during late fall, while the present test amply demonstrated the extreme hardiness of the plants during their early growth. When struck by the frost of May 20, which damaged the cereals and even hardy grasses, the plants averaged 4 inches high, yet not a leaf could be found which showed any subsequent damage from the frost, though the thermometer during the preceding night had registered a minimium of 18 degrees, or 8 degrees colder than what is commonly taken as killing frost. The plants became very stout, completely covered the row by August 8, when they started to blossom, and nevertheless averaged about as high as before, or 12 feet by the middle of September. By the time the plants were cut early in October, blackbirds and goldfinches had gathered the seed, and the test showed that the seed must be gathered early, for not all of it will ripen, no matter how long the fall season may last here.

Einkorn was planted May 12, headed out July 23 and was harvested September 19. This is a cereal recently imported from Europe and introduced by the U. S. Department of Agriculture. It somewhat resembles Speltz or Emmer, and if planted earlier will probably ripen about the same time. The straw was shorter, or 32 inches, and was of equally strong texture. Whatever value it may have will have to be demonstrated by further trials. Allowing the same weight per bushel, or 24 pounds, the plot yielded at the rate of 29.04 bushels of grain and 2,090 pounds of straw per acre.

FORAGE CROPS IN 1905.

The grass tests were confined to the varieties planted in 1901-02 and '03, the plots having been cut once or twice during each season, as their condition and the wet or dry weather warranted it, and none of the plots having been fertilized as yet. While some of the varieties did not give the large yield which they did during the preceding season, others yielded more, the largest increase being that of Bromus Inermis, which was planted in 1901 upon the poorest soil which could be found at that time. Upon the dry portion of the plot, the grass again averaged nearly 6½ feet high, and though it grew up again to a height of 20 inches after cutting, only one crop was removed. Those which gave a diminished yield did so owing to the dryer weather which more quickly affects such varieties as Timothy or Orchard Grass when planted as they are here upon soil whose natural drainage is better than the average.

Although the yield of the common clover was much larger than during the preceding season and seven crops have been removed since

1902, the stand was perfect at the close of the season. Upon the Alsike plot the other clovers have, however, crowded out this variety considerably during the past season, for the well-drained condition of the plot makes the soil less adapted to Alsike, and the increased yield cannot therefore be credited to this variety, nor can this plot serve any longer the purpose for which it was intended. For the purpose of determining the longevity of clover plants, the cutting of the other plots will be continued, and the plots left unplowed as long as the stand remains good and the yield profitable.

The yield of Alfalfa was the largest since 1901 when the plots were planted. The larger increased yield of the two plots which heretofore gave the lowest yield is partly due to the fact that the plants during the forepart of the season crowded out the grass and common clover plants which had been holding their own since 1902, for as stated in Special Bulletin No. 31, the stand of the four plots in 1904 ranged from the poorest, or about 65 per cent of a perfect stand for the Turkestan, to the best, or about 90 per cent for the German Alfalfa. At the close of the past season, the improved stand ranged from 80 to 95 per cent of a perfect stand, and the results show that Alfalfa plants, when once established, are even more aggressive than grass or clover plants.

The smaller yield of Sand Lucerne planted in 1904 is largely due to quack grass which was quite abundant on this plot when the seed was planted, and which, at the close of the past season, still represented nearly 40 per cent of the stand. As the plants are vigorous they will be left for the purpose of observing their ability in holding their own against what is commonly claimed to be the most persistent weed.

At the beginning of the season, the Alfalfa plots seemed to be destroyed without showing any evidence of disease or of damage from insects, the crowns of nearly all plants being partially or entirely dried up. Later on some of the plants which were dug up and whose root system appeared to be in a healthy condition, showed that numerous sprouts had started 2 to 4 inches below the crown. These sprouts continued to grow and account for the crowding out of the grass and clover plants. Later observations showed that a considerable portion of the crowns had revived, and among about 20 plants which had been dug up and whose roots were carefully inspected, one was found with a single nodule about the size of a small pinhead; the other plants, like all those which have been dug up during each preceding season, showing no evidence of bacterial work. Fifteen varieties of Alfalfa were started May 22 with seed furnished by the U. S. Department of Agriculture, enough seed being received for planting small plots of one square rod each. While the five varieties which head the list and which gave a yield of over 3,000 pounds per acre each, may possibly continue to give the largest yields, it is quite likely that the present yield was largely influenced by previous cultivation. These five were upon a plot which, in 1902, was badly infested with quack grass. Sugar beets were planted in 1903 and soy beans in 1904 and, owing to the intense cultivation, the plot when the Alfalfa was planted was entirely free from quack grass and other weeds. The next five were upon a plot which was cultivated in 1903 and had buckwheat in 1904. A large amount of volunteer buckwheat came up, and hand-weeding was necessary to save

the Alfalfa plants. The last five were upon a plot which received no cultivation during the two preceding seasons. White clover from an adjoining plot killed or held in check many of the Alfalfa plants on the east side of these five plots, and hand-weeding saved the rest. The seed of all varieties was quite pure, except that of Texas Panhandle 12801, which contained a large amount of Dodder and thereby caused this plot to give the lowest yield.

The low yield of *Crimson Clover* is due to adulterated seed. Fully two-thirds of the plants which came up were Giant Spurry.

The other varieties of clover which were tested are *White Clover* and *Yellow* or *Hop Clover*. The fine stems and abundant foliage as well as rampant habit of growth makes both of these varieties well adapted for pasture, but hardly for any other purpose.

Bokhara or *Sweet Clover* produced stout and healthy plants which proved very hardy, but did not blossom.

Planted May 24, the *Blue Lupin* blossomed July 31, reached a height of 40 inches and approximately 90 per cent of the pods ripened the seed perfectly. The *Yellow Lupin* blossomed August 6, reached a height of 30 inches and ripened about 60 per cent of its seed pods.

Seradella, planted May 24, blossomed July 18, and many of the small seed pods ripened. The vines average 3 feet in length and remain green until the beginning of winter, being damaged but very little by the severest frosts. The Soy Beans were planted May 31. The *Ogemaw* variety blossomed August 7 and ripened every pod. *Early Black* blossomed August 13 and ripened nearly as well, about 20 per cent of the beans being slightly shrunken after curing. *Extra Early Black* blossomed August 14. One-half of the beans were well ripened, the balance shrunk more or less while curing. *Ito San* blossomed August 20, the stout and many branched vines reaching a height of 45 inches. The pods were well filled, but none ripened completely. *Medium Green Soy* blossomed August 30, and only a few of the lower pods were well filled at the close of the season. The roots of the Ogemaw variety were provided with numerous and generally very large nodules, these being the first ever seen here. None could be found upon the roots of any other variety.

The Cow Peas were planted June 3, except the *Black Eyed* variety, which was planted May 31 and blossomed August 31. *Michigan Favorite* blossomed September 2, *New Era* September 4, and *Extra Early* did not blossom. No pods were found on any variety. The vines remained in fair condition until the forepart of October and averaged 3 to 7 feet in length.

Horse Beans.—The *English* or *Broad Windsor* variety was planted May 27, blossomed July 9 and ripened most of its pods before the middle of September. The stout and hardy vines averaged 42 inches high. The pods are 4 inches long by 1 to 1¼ inch wide, growing upright until well filled, drooping and being slightly curved when ripening, and containing each 2 to 4 large beans, flat in shape and ⅞ to 1⅛ inch in diameter.

Lathyrus Sylvestris (*Wagnerii*).—Planted in 1904, blossomed July 17 and ripened all pods which were not shaded too much by the dense growth of the vines. The large clusters of blossoms are as ornamental as those of the Sweet Peas, the clusters and individual blossoms being

larger but not scented. The vines averaged 6 feet long, blossomed until the forepart of September and are extremely hardy.

Pearl or Cat Tail Millet, headed out September 4 and reached an average height of 8½ feet, but ripened no seed.

Teosinte did not head out but made a dense growth which averaged 6½ feet high at the close of the season.

The yields of the varieties are shown in the following table:

Varieties.	Size of plots in rods.	Time of planting.	Time of cutting.	Yield per cutting in bs.	Total yield of plots in lbs.	Yield per acre in lbs.
Turkestan Alfalfa	1x6	May, 1901	July 13	184		
Turkestan Alfalfa			Aug. 21	94		
Turkestan Alfalfa			Sept. 20	58	336	8,960
French Alfalfa	1x6	May, 1901	July 13	189		
French Alfalfa			Aug. 21	99		
French Alfalfa			Sept. 20	60	348	9,280
German Alfalfa	1x6	May, 1901	July 13	209		
German Alfalfa			Aug. 18	123		
German Alfalfa			Sept. 20	94	426	11,360
American Alfalfa	1x6	May, 1901	July 13	205		
American Alfalfa			Aug. 18	117		
American Alfalfa			Sept. 20	86	408	10,880
Sand Lucerne	1x6	May, 1904	July 17	78		
Sand Lucerne			Aug. 18	38	116	3,093⅓
Sand Lucerne, U. S. D. Ag	1x1	May 22, 1905	Aug. 22	23	23	3,680
Colorado Alfalfa 12,398	1x1	May 22, 1905	Aug. 22	24	24	3,840
New York Alfalfa 13,291	1x1	May 22, 1905	Aug. 22	20	20	3,200
Nebraska Alfalfa 12,820	1x1	May 22, 1905	Aug. 22	20	20	3,200
Arizona Alfalfa 2,518	1x1	May 22, 1905	Aug. 22	19	19	3,040
Inoculated Alfalfa 1,885	1x1	May 22, 1905	Aug. 18	17½	17½	2,800
Minnesota Alfalfa 2,521	1x1	May 22, 1905	Aug. 18	10½	10½	1,680
Ontario Alfalfa 2,131	1x1	May 22, 1905	Aug. 18	12	12	1,920
Northern Montana Alfalfa 13,237	1x1	May 22, 1905	Aug. 18	7	7	1,120
Kansas Alfalfa 2,531	1x1	May 22, 1905	Aug. 18	6½	6½	1,040
Utah Alfalfa 2,532	1x1	May 22, 1905	Aug. 18	14	14	2,240
Texas Alfalfa 2,533	1x1	May 22, 1905	Aug. 18	11½	11½	1,840
Kansas Alfalfa 2,530 under irrigation	1x1	May 22, 1905	Aug. 18	9	9	1,440
Southern Montana Alfalfa 12,747	1x1	May 22, 1905	Aug. 18	9	9	1,440
Texas Panhandle Alfalfa	1x1	May 22, 1905	Aug. 18	5½	5½	880
Crimson Clover	1x6	May 19, 1905	Aug. 22	48	48	1,280
June Clover	1x6	May, 1902	July 10	162		
June Clover			Sept. 7	87	249	6,640
Alsike Clover	1x6	May, 1902	July 10	216		
Alsike Clover			Sept. 15	66	282	7,520
Silesian Clover	1x6	May, 1902	July 10	150		
Silesian Clover			Sept. 7	90	240	6,400
Mammoth Clover	1x6	May, 1904	July 10	330		
Mammoth Clover			Sept. 7	165	495	13,200
Tall Meadow Oat Grass	1x6	May, 1903	July 15	126		
Tall Meadow Oat Grass			Sept. 15	60	186	4,960
Timothy	1x6	May, 1902	July 25	114	114	3,040
Orchard Grass	1x6	May, 1902	July 13	72	72	1,920
Red Top	1x6	May, 1902	July 26	147	147	3,920
Meadow Foxtail	1x6	May, 1903	July 14	132	132	3,520
Kentucky Blue Grass	1x6	May, 1903	July 15	138	138	3,680
Bromus Erectus	1x6	May, 1903	July 19	102	102	2,720
Slender Wheat Grass	1x6	May, 1903	July 25	185	185	4,933⅓
Meadow Fescue	½x6	May, 1903	July 18	129	129	6,880
Siberian Millet	1x4½	May 30, 1905	Aug. 21	126	126	4,480
New Japanese Millet	88x12 ft.	May 30, 1905	Aug. 26	301	301	12,416¼
Bromus Inermis	4,989 sq. ft	May, 1901	July 26	636	636	5,597½
Mixed Grasses	2 1-24 ac's.	July, 1903	July 17-21	8,575	8,575	4,200

FORAGE CROPS IN 1906.

The new growth started earlier than usual, but none of the varieties made much headway until June, owing to the dry weather of April and May. To this alfalfa was an exception, the plants being about 10 inches high on May 20 when most of the new growth was killed by frost. The first two cuttings were subsequently made just before the blossoms opened up, and this seemed to assist the plants in recuperating, and probably accounts for the fact that the third crop was practically as large as the second. From the plots which were planted in 1905, only two crops were removed, it being considered better practice to begin the removing of three crops only after the plants are two years old. Clover was damaged as much as alfalfa on May 20, and as the plots seemed to be permanently injured, the June clover plot planted in May, 1902, was plowed up. Most of the plants on the Silesian clover plot which was planted at the same time, recovered later on, and at the end of the season the plot was still in fair condition. Owing to very favorable weather conditions at harvesting time, the high quality of all hay crops somewhat compensated for the lower yields.

For peas and oats which were cut for hay, the Early Champion oats and the French June variety of peas were used at the rate of 2 bushels of oats and one of peas per acre. These two varieties come nearest ripening together and their earliness merely adds to their value as one of the most desirable hay crops.

For wheat and vetch, a mixture of spring wheat varieties and the Sand or Winter vetch (Vicia Villosa) was used. This is a hay crop fully as valuable if cut early, or when the wheat begins to enter the dough stage. During early fall the vetches started a new growth, and by the end of the season the ground was completely covered with the green vines.

Hungarian Millet was tested for the first time. This is a well-known variety, and owing to its fine stems and abundant foliage, one of the most desirable for hay. The plot should have been cut ten days earlier than it was, for like all Foxtail millets, the bristles of the seed heads are apt to injure stock if the crop is cut late.

Soy Beans.—The Ogemaw, Early Black and Extra Early Black were planted June 6 with seed which ripened here in 1905. They blossomed August 2, 6 and 7, respectively, and were completely ripe early in October.

Horse Beans.—Several varieties were planted May 17, or ten days earlier than in 1905. The plants grew rapidly, reached a height of 38 to 52 inches and remained thrifty until the lower pods were about ripe. Thereafter the edge of the leaves and the pods turned black and the beans became more or less discolored. *German Antwerp*, the earliest of these varieties, was affected much less and hardly ten per cent of the ripe beans showed any discoloration. *Japanese Muroran*, from seed kindly donated by E. E. Evans, the legume specialist of the Ogemaw Grain & Seed Co., of West Branch (Mich.), who introduced this variety for the first time and states in regard to it that "the beans are used as human food in its native country and are grown principally in Kentucky, where they are used for "hogging off." The stem and foliage resembles those of Soy beans, but the variety is a species of Phaseolus,

and the yellow blossoms are as large as those of the common beans, but are borne close to the main stem. The stems which carry the clusters of seed pods gradually extend 5 to 7 inches away from the main stem, and the small, cylindrical pods average 4 inches in length with generally nine very small beans colored deep crimson, with a white dot or "eye." The plants were 24 inches high. The beans were planted June 1. The first blossoms opened August 6, and the pods ripened in succession from the 10th to the end of September.

Chinese Sago, also planted June 1, is a closely related variety, but much later and only a few pods ripened.

The following table gives the yield of the varieties:

Varieties.	Size of plots in rods.	When planted.	Time of harvesting	Yield of each cutting. Lbs.	Total yield of plots. Lbs.	Yield per acre. Lbs.
German Alfalfa	1x6	May, 1901	June 30	127		
German Alfalfa			Aug. 2	75		
German Alfalfa			Sept. 9	74	276	7,360
American Alfalfa	1x6	May, 1901	June 30	111		
American Alfalfa			Aug. 2	74		
American Alfalfa			Sept. 9	73	258	6,880
French Alfalfa	1x6	May, 1901	June 30	108		
French Alfalfa			Aug. 2	71		
French Alfalfa			Sept. 9	58	237	6,320
Turkestan Alfalfa	1x6	May, 1901	June 30	114		
Turkestan Alfalfa			Aug. 2	48		
Turkestan Alfalfa			Sept. 9	42	204	5,440
Sand Lucerne	1x1	May, 1905	July 10	25		
Sand Lucerne			Aug. 25	23	48	7,680
Colorado Alfalfa 12,398	1x1	May, 1905	July 10	22		
Colorado Alfalfa			Aug. 25	24	46	7,360
Kansas Alfalfa 2,531	1x1	May, 1905	July 10	12		
Kansas Alfalfa			Aug. 25	5	17	2,720
Northern Montana Alfalfa 13,237	1x1	May, 1905	July 10	12		
Northern Montana Alfalfa			Aug. 25	14	26	4,160
Ontario Alfalfa 2,131	1x1	May, 1905	July 10	23		
Ontario Alfalfa			Aug. 25	15	38	6,080
Nebraska Alfalfa 12,820	1x1	May, 1905	July 10	23		
Nebraska Alfalfa			Aug. 25	23	46	7,360
Minnesota Alfalfa 2,521	1x1	May, 1905	July 10	15		
Minnesota Alfalfa			Aug. 25	10	25	4,000
Inoculated Alfalfa 1,885	1x1	May, 1905	July 10	18		
Inoculated Alfalfa			Aug. 25	10	28	4,480
New York Alfalfa 13,291	1x1	May, 1905	July 10	21		
New York Alfalfa			Aug. 25	22	43	6,880
Arizona Alfalfa 2,518	1x1	May, 1905	July 10	21		
Arizona Alfalfa			Aug. 25	21	42	6,720
Texas Panhandle Alfalfa 12,801	1x1	May, 1905	July 10	13		
Texas Panhandle Alfalfa			Aug. 25	2	15	2,400
Southern Montana Alfalfa 12,747	1x1	May, 1905	July 10	16		
Southern Montana Alfalfa			Aug. 25	7	23	3,680
Kansas Under Irrigation Alfalfa 2,530	1x1	May, 1905	July 10	10		
Kansas Under Irrigation Alfalfa			Aug. 25	6	16	2,560
Texas Alfalfa 2,533	1x1	May, 1905	July 10	11		
Texas Alfalfa			Aug. 25	7	18	2,880
Utah Alfalfa 2,532	1x1	May, 1905	July 10	16		
Utah Alfalfa			Aug. 25	13	29	4,640
Silesian Clover	1x6	May, 1902	July 2	97		
Silesian Clover			Aug. 25	71	168	4,480
Mammoth Clover	1x6	May, 1904	July 10	237		
Mammoth Clover			Sept. 2	159	396	10,560

Varieties.	Size of plots in rods.	When planted.	Time of harvesting.	Yield of each cutting. Lbs.	Total yield of plots. Lbs.	Yield per acre. Lbs.
Tall Meadow Oat Grass	1x6	May, 1903	July 9	129	129	3,440
Timothy	1x6	May, 1902	July 9	96	96	2,560
Orchard Grass	1x6	May, 1902	July 5	66	66	1,760
Red Top	1x6	May, 1902	July 10	93	93	2,480
Kentucky Blue Grass	1x6	May, 1903	July 5	102	102	2,720
Slender Wheat Grass	1x6	May, 1903	July 10	156	156	4,160
Meadow Fescue	½x6	May, 1903	July 5	93	93	4,960
Mixed Grasses (Timothy and Red Clover)	4½ acres	July, 1903; May, 1904	July 10-12	12,510	12,510	2,780
Mixed Grasses (Red Top and Alsike Clover)	¾ acre	July, 1903	July 16	2,484	2,484	3,312
Hungarian Millet	1x6 rods	May 31	Aug. 25	324	324	8,640
Peas and Oats	1-10 acre	May 8	July 31	467	467	4,670
Wheat and Vetch	1-10 acre	May 8	Aug. 2	519	519	5,190

POTATOES AND ROOT CROPS IN 1905.

The varieties of potatoes are those which have been tested for two years or more and they were planted upon the highest ground south of the creek while expecting that the draining of this large area would be completed before any damage would result from its wet condition to which attention had been called each year. As stated elsewhere, this drainage was not continued, and to this is due the total failure of some varieties and the large proportion of unmerchantable potatoes of all others. The ten varieties at the bottom of the following table were planted on the south portion of the plots where the ground is from one to two feet lower. Adjoining these on equally low ground were planted duplicate plots of Sir Walter Raleigh and nine other of such varieties as have usually given profitable yields, these additional ten varieties occupying each one row 670 feet long. The results from these duplicate plots are not given in the following table, for beginning with the forepart of September until the end of the season, the water stood two to six inches deep upon these and a large portion of the adjoining plots, and as a consequence the failure was complete. The more favorable results from the northern or dryer portion of the plots, merely indicate that this soil is well adapted to potatoes whenever it may be put into such reasonably dry condition which every potato grower knows to be indispensable.

The yields of the plots are shown in the following table:

(ROWS FOUR FEET APART.)

Varieties.	Length of row in feet.	Time of planting.	Time of blossoming.	Yield of plots in lbs.			Yield per acre in bushels.
				Large.	Small.	Total.	
Delaware	335	May 29	July 19	273	106	379	275.15
Carman No. 3	1,335	June 10	July 18	1,487	521	2,008	272.99
Northern Beauty	200	May 31	July 19	277	118	395	358.45
Honeoye Rose	200	May 31	July 19	152	118	270	245.02
Pinkeye	200	May 31	July 25	162	64	225	205.09
Million Dollar	1,000	June 10	July 22	925	187	1,112	201.82
Dolsen	400	May 31	July 22	307	147	454	206
Admiral Dewey	500	May 31	July 21	365	125	490	177.87
Wonderful	265	May 31	July 23	150	97	247	169.17
Northlight	400	May 29	July 26	251	95	346	156.99
Hurst	400	June 10	July 21	208	115	323	146.56
Up to Date	335	May 29	July 18	163	109	272	147.36
Sir Walter Raleigh	335	May 31	July 25	313	28	341	184.75
Norther	335	May 29	July 17	79	126	205	111.06
Harrington Peer	335	May 27	July 17	105	32	137	74.22
Pride of Michigan	335	May 31	July 20	56	98	154	83.43
Rose of Erin	335	June 10	July 20	97	48	145	78.55
Dew Drop	335	May 27	July 22	83	42	125	67.72
Pingree	335	May 27	July 16	80	40	120	65
Wonder of the World	335	May 29	July 17	58	25	83	44.96
Rosy Morn	335	May 29	July 18	15	40	55	29.79

CONTINUATION OF POTATO EXPERIMENTS.

The experiments of the past three seasons were continued during 1905 with the four varieties used in 1904. One-quarter of an acre was planted during the fall of 1904 and a like amount during spring of 1905. The total length of the plot was 16 rods. The width which was 5 rods was divided into 24 parts, thus making the rows nearly 3½ feet apart, and as three rows of each variety were planted both for hilling up and for level cultivation, the subdivisions in the following tables represent each 1-64 part of an acre. The season was less favorable for potatoes than 1904, owing to late blight which made its appearance during the forepart of September. The tubers remained sound, but the premature death of the vines arrested the further development of the late varieties, and thus the fall planted varieties, which have invariably been farther advanced, gained a greater advantage than they did during former seasons. Owing to the absence of early blight and to the fact that a small knapsack sprayer constitutes the entire spraying outfit, only two sprayings were given, namely one on June 28 and the other July 13, one-half of the vines being sprayed as formerly with Bordeaux mixture and Paris green, and the other half with Paris green alone. In the southern portion of the Upper Peninsula, late blight, judging from numerous inquiries for a remedy, appeared earlier and was much more severe, it being stated that in some instances almost the entire crop was destroyed. It should not be surmised therefore that the two sprayings warded off the damage here, for they did not, and the practice of giving only two sprayings is by no means recommended even during seasons with the forepart as favorable as it was here during the present season. When done once every two weeks and with an economical outfit, spraying will pay, otherwise it will not, for insufficient spraying affords insufficient immunity from diseases.

The potatoes were cultivated June 17 and 27 and July 3 and 8, after

which one-half were hilled up July 13 and the others received one more level cultivation July 15. The small difference in favor of level cultivation is no doubt due to late blight, which probably affects potatoes which are close to the surface quicker than those which are protected by a greater depth of soil. While former experiments here as well as elsewhere have shown level cultivation to be more profitable than hilling up, "ridging" or partial hilling up at the last cultivation is suggested as still more profitable during wet seasons when late blight is prevalent.

Further observations of the effects of Paris green upon potato beetles showed that for 100 gallons of water 2½ pounds of Paris green are safer than 2 pounds, at least until a law may be enacted which will require the inspection and branding of Paris green. The fall planting was done November 5, 7 and 9, and in order to find out whether extra early planting would cause the spring planted potatoes to come up as early as the fall planted, the spring planting was done May 18 and 20 when the ground was still too cold and investigations had shown that the fall planted potatoes were still in a dormant condition. The earlier planting left the spring planted potatoes as much behind as during former seasons, although different results had been anticipated.

The time of sprouting and blossoming is shown in the following table, the date of sprouting being the time when the rows could be clearly distinguished.

Fall planted.		Varieties.	Spring planted.	
Time of sprouting.	Time of blossoming.		Time of sprouting.	Time of blossoming.
June 13	July 8	Delaware	June 19	July 16
June 14	July 9	Carman No. 3	June 20	July 15
June 15	July 9	Rose of Erin	June 22	July 17
June 17	July 13	Sir Walter Raleigh	June 25	July 20

The yield of the varieties is shown in the following table.

TABLE OF FALL PLANTED POTATOES.

Sprayed or unsprayed.	Varieties.	Cultivated level.				Hilled up.			
		Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre. in bushels.	Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre. in bushels.
Sprayed	Sir Walter Raleigh	252	12	264	281.60	240	15	255	278.66
"	Carman No. 3	156	26	182	194.13	166	28	194	206.93
"	Rose of Erin	164	24	188	200.53	171	27	198	211.20
"	Delaware	191	22	213	227.20	180	24	204	217.60
Not sprayed	Sir Walter Raleigh	248	12	260	277.33	242	12	254	270.93
"	Carman No. 3	159	29	188	200.53	162	28	190	202.66
"	Rose of Erin	161	24	185	197.33	159	27	186	198.40
"	Delaware	190	24	214	228.26	194	21	215	229.33
	Total	1,521	173	1,694	....	1,514	182	1,696	....

TABLE OF SPRING PLANTED POTATOES.

Sprayed or unsprayed.	Varieties.	Cultivated level.				Hilled up.			
		Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre in bushels.	Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre in bushels.
Sprayed........	Sir Walter Raleigh.........	235	17	252	268.80	232	14	246	262.40
"	Carman No. 3............	150	34	184	196.26	156.2	29	185	197.33
"	Rose of Erin............	152	25	177	188.80	160	28	188	200.53
"	Delaware............	180	26	206	219.73	169	31	200	213.33
Not sprayed......	Sir Walter Raleigh.........	239	18	257	274.13	221	26	247	263.46
"	Carman No. 3............	142	28	170	181.33	150	28	178	189.86
"	Rose of Erin............	150	27	177	188.80	148	22	170	181.33
"	Delaware............	177	38	215	229.33	186	28	214	228.26
	Total............	1,425	213	1,638	....	1,422	206	1,628	....

SUMMARY OF RESULTS.

	Pounds.
Total yield of fall planted........................	3,390
Total yield of spring planted........................	3,266
In favor of fall planting........................	124
Level cultivation........................	3,332
Hilled up........................	3,324
In favor of level cultivation........................	8
Sprayed........................	3,336
Not sprayed........................	3,320
In favor of sprayed........................	16

Potatoes in 1906.—The season may be noted for largest yields ever obtained before, and for superior quality as well. This was principally due to a total absence of early blight and accounts for the fact that the increased yield of the early varieties was proportionately greater than that of the late varieties, for on the other hand, late blight came earlier and was of more than average virulence, but as a fairly good spray pump was secured in time, the blight was effectively checked by spraying the vines with Bordeaux Mixture. The varieties used have been tested several years except the Green Mountain, the seed of which was kindly donated by the E. L. Cleveland Co., of Houlton (Maine). The variety is of the Carman type and constitutes the main market crop in the potato districts of Maine. Oblong and slightly flattened, the potato has the square shaped form of the leading market varieties. It's white and finely netted skin, shallow eyes, fine grained flesh and good keeping qualities ought to command it as a desirable market crop. It ripens about a week earlier than Carman. The plot was on a side hill, from which most of the top soil was originally removed, and on better ground the yield would have been no doubt still larger. All seed potatoes were treated with formalin for the prevention of scab and the treatment was effective on all plots except the one upon which the varieties in the following table were tested and where about 15% of the potatoes were more or less scabby when harvested. Evidently this was due to the fact that the same ground had been used for pota-

toes in 1903 when no treatment for scab had been applied. Though this ground has been plowed each year, the test would seem to indicate that a longer time is necessary before it is safe to plant potatoes upon scab-infested ground.

The rows were 4 feet apart and one to five rows of each variety were planted. As the plot is irregular in shape, the space occupied by each variety is given in number of square feet and the yield is shown in the following table:

Varieties.	Size of plot. Sq. ft.	When planted.	Time of blossoming.	Yield of plot in lbs. Large.	Yield of plot in lbs. Small.	Yield of plot in lbs. Total.	Yield per acre. Bushels.
Rosy Morn	280	May 24	July 16	60	15	75	194.46
Irish Cobbler	480	" 23	" 16	120	7½	127½	204.18
Green Mountain	560	" 23	" 12	127½	15	142½	213.90
Six Weeks	280	" 24	" 16	67½	7½	75	194.46
Up to Date	400	" 23	" 15	105	15	120	217.80
Dew Drop	600	" 23	" 14	165	15	180	217.80
Northlight	600	" 23	" 20	180	7½	187½	226.87
Admiral Dewey	600	" 22	" 13	210	7½	217½	263.17
Hurst	600	" 23	" 18	120	15	135	163.35
Dolsen	1,200	" 21	" 16	435	15	450	272.25
Million Dollar	1,200	" 21	" 15	420	15	435	263.17
Delaware	1,540	" 21	" 10	405	30	435	205.07
Carman No. 3	1,250	" 21	" 12	420	30	450	261.36
Rose of Erin	1,250	" 21	" 13	405	60	465	263.74
Sir Walter Raleigh	1,250	" 21	" 20	420	15	435	252.64

POTATOES ON MUCK SOIL.

Muck, when well drained and not acid, is generally considered well adapted to potatoes and more especially to high grade seed potatoes, for the muck seems to have the ability to prevent the development of scab and the tubers have a brighter and glossier appearance though the yield is claimed to be less than from better grades of potato soils. Since muck is the residue of organic matter slowly decomposed in the presence of more than an ordinary amount of water, its presence implies a level area in the vicinity of hills or higher ground from which a portion of the vegetable matter has been carried down. As cold air during frosty nights rolls down from the higher and accumulates upon the lower and level ground below, it therefore implies as well that potatoes on muck ground are more subject to damage from frost than they are upon the higher ground. A greater immunity from unseasonable frosts is afforded by muck beds, such as those of the station grounds which are close to a creek and about 35 feet above it, for a large volume of cold air will rapidly follow the downward course of the creek.

In various portions of the Upper Peninsula there are extensive muck beds, such as those near Newberry. More or less acidity may be expected in some of these. Others will be found nearly or entirely free from acid, and this more especially applies to those within the extensive region which comprises the Calciferous, Trenton and other limestone formations, for these beds are underlaid with limestones and frequently marl, the lime of which acts as a neutralizing agent. The muck bed of

the station grounds belongs to the latter class, being $2\frac{1}{2}$ to 4 feet deep and resting upon a ledge of calciferous rock the thickness of which is 100 feet or more. The portion used is fairly well drained by means of tiling. The planting was done May 25, and, owing to a delay in receiving the seed, the California Russet was planted June 6. Earlier planting will probably give better results with this variety than those obtained during the first test, the potatoes otherwise having an attractive appearance, being oblong and roundish with few and very shallow eyes and skin prominently russetted.

The following table gives the yield of the six varieties which were tested.

POTATOES ON MUCK SOIL, IN ROWS FOUR FEET APART.

Varieties.	Size of plots.	Time of blossoming.	Yield of plot in lbs.			Yield per acre.
	Sq. ft.		Large.	Small.	Total.	Bushels.
Wonderful	800	July 19	180	15	195	176.96
Northern Beauty	880	" 18	330	15	345	284.62
Harrington Peer	880	" 14	210	15	225	185.62
California Russet	880	" 31	135	15	150	123.75
Dolsen	4,400	" 19	1,470	75	1,545	254.92
Delaware	880	" 19	330	30	360	297

CONTINUATION OF POTATO EXPERIMENTS.

A smaller plot, or 7-48 of an acre was used for the experiments which have been carried on since 1902. The fall planting was done November 9 and 10 and the spring planting was again done extra early, or May 15 and 16. Three rows each of Delaware and Rose of Erin, and four rows each of Carman No. 3 and Sir Walter Raleigh were planted, the rows being $3\frac{1}{2}$ feet apart and 4 rods long, thus making each subdivision of three rows, as shown in the table of yields, equal to 1-256 acre, while the four rows subdivisions represent 1-192 acre. As hereafter shown, the sprouting and blossoming of the fall planted potatoes were again earlier by several days and the ripening was 10 to 12 days earlier. Adjoining the plot on the west side was the barley plot mentioned as having been partially destroyed by cutworms, and it was not until after all the spring planted potatoes were up that it was fully ascertained that the insects had also been working on the fall planted potatoes and destroyed the sprouts before they appeared above ground. The four rows of Sir Walter Raleigh nearest the barley plot were entirely destroyed at the south end, which includes the subdivision subsequently hilled up and sprayed. Adjoining this variety was the Rose of Erin, and for this reason the hilled up and sprayed subdivision of this variety was damaged most. More or less of the south end of the rows of the other two varieties was likewise destroyed, and that the insects quit working before they reached much farther east is shown by the yields of Sir Walter Raleigh and Rose of Erin on the east side of the plot which includes the subdivisions cultivated level and sprayed. The unsprouted seed potatoes, as found on June 20, were still sound, and as a few had one or more unsprouted eyes left, there

were new sprouts coming up as late as July 9. As a result of this unusual damage the difference in yield during this test is considerably in favor of the spring planted potatoes. Level cultivation gave much better results than hilling up, though the showing was made possible by the cutworms rather than by the method of cultivation. On the other hand it is well to bear in mind that the hilling up method in this and former tests was generally preceded by four level cultivations and was thus given a greater advantage than it receives at the hands of those who practice it and who rarely cultivate at first more than once, following this by hand hoeing. The most striking results were those obtained from spraying with Bordeaux Mixture, for the difference in this case would have been much larger had it not been for the cutworms, whose damage was principally confined to the sprayed portion of the fall planted potatoes. Even as it is, the difference of 97 pounds in favor of spraying is equal to an increase of over 22 bushels per acre. As the cost of the material added to the Paris green would not exceed 70 cents per acre, and the labor, if the potatoes are otherwise sprayed for bugs, would be practically the same, it is easy to figure out whether or not it pays to spray. The time of sprouting and blossoming is given in the following table:

Fall planted.		Varieties.	Spring planted.	
Time of sprouting.	Time of blossoming.		Time of sprouting.	Time of blossoming.
June 9	July 6	Delaware	June 13	July 11
June 9	July 7	Rose of Erin	June 16	July 12
June 12	July 9	Carman No. 3	June 16	July 13
June 16	July 14	Sir Walter Raleigh	June 19	July 20

The potatoes were cultivated June 15, 22 and 30, July 9 and 18; the hilling up being done on the last day, and the other half of the plot receiving two more level cultivations July 25 and August 2. The spraying was done June 25, July 5, 16 and 26, August 8 and 20.

TABLE OF FALL PLANTED POTATOES.

Sprayed or unsprayed.	Varieties.	Cultivated level.				Hilled up.			
		Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre. bushels.	Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre. bushels.
Sprayed	Delaware	70	5	75	320	100	5	105	448
"	Rose of Erin	74	7	81	345 3-5	38	4	42	179 1-5
"	Carman No. 3	90	6	96	307 1-5	82	6	88	281 3-5
"	Sir Walter Raleigh	80	8	88	281 3-5	6	6	6	19 1-5
Not sprayed	Delaware	40	8	48	204 4-5	83	4	87	371 1-5
"	Rose of Erin	58	5	63	268 4-5	62	4	66	281 3-5
"	Carman No. 3	58	6	64	204 4-5	87	5	92	294 2-5
"	Sir Walter Raleigh	86	6	92	294 2-5	80	8	88	281 3-5
	Total	556	51	607	....	538	36	574	....

TABLE OF SPRING PLANTED POTATOES.

Sprayed or unsprayed.	Varieties.	Cultivated level.				Hilled up.			
		Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre. In bushels.	Large. Lbs.	Small. Lbs.	Yield of plot. Lbs.	Yield per acre. in bushels.
Sprayed	Delaware	75	6	81	345 3-5	104	4	108	460 4-5
"	Rose of Erin	70	8	78	332 4-5	74	4	78	332 4-5
"	Carman No. 3	128	8	136	435 1-5	104	4	108	345 3-5
"	Sir Walter Raleigh	119	9	128	409 2-5	111	5	116	371 1-5
Not sprayed	Delaware	55	8	63	268 4-5	80	4	84	358 2-5
"	Rose of Erin	62	7	69	294 2-5	65	4	69	294 2-5
"	Carman No. 3	96	8	104	332 4-5	95	5	100	320
"	Sir Walter Raleigh	111	9	120	384	104	4	108	345 3-5
	Total	716	63	779	....	737	34	771	....

SUMMARY OF RESULTS.

	Pounds.
Total yield of fall planted	1,181
Total yield of spring planted	1,550
In favor of spring planting	369
Total yield of level cultivation	1,386
Total yield of hilled up	1,345
In favor of level cultivation	41
Total yield of sprayed	1,414
Total yield of not sprayed	1,317
In favor of spraying	97

SUGAR BEETS IN 1905.

The seed which ripened in 1904 was planted May 20, the two varieties being Jaensche's Victrix and Meyer's Fredeückswerther Elite. Imported seed of the former variety was planted on the same day for the purpose of noting the difference in growth and yield of the beets when compared with those from the home-grown seed. This difference became very conspicuous soon after the beets were large enough for thinning out, and was greatly intensified when the beets attained their full growth. The glossiness, deeper shade of green and larger size of the leaves made it appear as if the beets from the home-grown seed had been highly fertilized, and the final weight of the beets showed that the roots had fully responded to the healthier growth of the tops. It was not expected that the test for sugar would show a similar difference. Nor would such a difference have been anything more than accidental had it been found, for the mother beets had not been tested, and obviously beet seed growing by this or any other method cannot give any satisfactory results unless this station is provided with the necessary apparatus for testing on the ground such beets whose composition shows them to be adapted for the raising of high grade seed.

The entire plot occupied one-tenth of an acre, of which one-half was planted with Jaensche's Victrix imported seed, and the other half was

evenly divided between Meyer's Fredrickswerther Elite and Jaensche's Victrix, both from home-grown seed. Four sample beets to be tested for sugar were shipped October 17 to the Michigan Experiment Station, and a like number were shipped on the same day to the Menominee River Sugar Co.

The tests and the yields are shown in the following table:

Varieties.	Origin of seed.	Weight of beets when shipped to: Menominee River Sugar Co. Ounces.	Weight of beets when shipped to: Michigan Experiment Station. Ounces.	Weight of beets when received by: Menominee River Sugar Co. Ounces.	Weight of beets when received by: Michigan Experiment Station. Ounces.	Sugar content at: Menominee River Sugar Co.	Sugar content at: Michigan Experiment Station.	Yield of plots in lbs.	Yield per acre in lbs.
Jaensche's Victrix	Home grown	24	23½	23½	....	14.7	16.1	910	36,400
" "	Home grown	21½	27	21	....	13.3	15.1		
Meyer's Fredrickswerther Elite	Home grown	30	28	29	....	14.4	15.9	940	37,600
Jaensche's Victrix	Imported	22	32	21½	....	13.3	15.9	1,540	30,800

As related in Special Bulletin No. 31, page 20, the mother beets from which the home-grown seed was obtained, were grown in 1903, left undisturbed over winter and allowed to grow seed in 1904. As no means are at hand for testing such mother beets, the fact that the beets which were raised from their seed tested somewhat higher than the beets from the imported seed, may therefore be considered accidental. The thriftier growth and much larger yield of the beets from home-grown seed are sufficiently conspicuous, however, for anticipating results of more than average importance should this station be provided with the necessary means for the systematic growing of beet seed.

CARROTS, TURNIPS AND SUNDRY ROOTS.

The very large yields of former years were exceeded during the present season by nearly all varieties except the table beets which were more or less damaged by scab, the *Improved Long Dark Blood* variety being an exception, and the immunity, if existing, being no doubt due to the fact that these beets grow mangel fashion, i. e., partly above ground. Observations with the other varieties showed that the point of attack begins at the base of the leaf stalks which, being close to the ground, afford more favorable moisture conditions for the development of the scab fungus. Of the other root crops, the Rutabaga is generally considered the most important in this region, not so much on account of the large yield, as on account of the better keeping quality, and especially on account of the large quantities which are in demand for table use in camps and mills. Practically all the known varieties have been tested during the past six years and none has been found which would answer the description of a perfect root for table use. Fine grained flesh, a perceptible amount of sweetness, medium size, perfect form and smooth skin are all more nearly combined in *Carter's Hardy*, heretofore tested,

than in any other variety, yet the roots are generally "necky," and this means a certain amount of woodiness in the upper half. *Perfection White Swede* is the only variety which is free from necks, hence woodiness, but the flesh is rather coarse and not sweet.

Of the strap-leaf or common turnips most of the varieties have also been tested, and among these the globe-shaped forms constitute the most desirable varieties, the white or purple tops for early, and the yellow or orange fleshed for medium late. For table use, all the varieties which have been tested, must be used before the are full grown.

Practically all the varieties of parsnips have been tested. Of these, the *Long White Dutch* variety does not yield best, but is decidedly the best for quality. None of the roots of any variety have ever been damaged by leaving them unharvested until the following spring, and the quality of all is very much improved thereby. The same applies to salsify, certain varieties of carrots and, in fact, all roots which grow entirely below the surface of the ground.

As for roots exclusively adapted for stock feeding, such as mangels, or the half sugar or true sugar beets, recommendations as to which are the most valuable will be superfluous if the choice of varieties will be left to the cow or its stable companions. Wherever beet pulp can be secured at a low cost of transportation and handling, none of these varieties can be recommended from an economical standpoint. On the other hand, if the feeding value of sugar is to be taken into consideration, it will seem obvious that the mangel is the least valuable among these varieties. Its popularity is mainly due to ease of harvesting; yet between the mangel as one and the sugar beet as the other extreme, stands the half sugar beet or mangel beet as a happy medium, and combining as it does some of the good qualities of both, it may be safely recommended as the most valuable variety for milch cows or sheep, and especially as a winter feed for pregnant animals. Elsewhere the mangel frequently outyields the other varieties. Here it has not done so; neither will it do it in any new timbered region, for the larger yield will only be obtained from a deep and well fertilized soil which has been worked for a number of years.

All of the foregoing remarks and recommendations are made while anticipating that no extensive work with root crops will hereafter be made at this station. Early or backward, hot or cold, wet or dry, the weather conditions have but slightly affected any of the varieties, and the yields of all have been uniformly large. No less should be expected from any, nor from other hardy vegetables such as lettuce, radishes, etc., in a region with more than an average amount of moisture, where growth is hastened by a greater amount of daylight and twilight during the growing season; where the highest quality expressed by crispness is thereby secured as well as by the abundant and refreshing dews which are insured by the generally cool nights following even the hottest days; and where, owing to these climatic conditions, plants of this and similar character, are endowed with greater vigor, hence greater recuperative power when subjected to adverse weather conditions.

Cultural experiments, owing to the unique winter conditions, will be deemed of greater interest hereafter than the testing of varieties. This, however, does not apply to sugar beets, for the different phases of the sugar beet problem have been worked out during the past four years

as well as they can ever be with the present lack of equipment, and temporarily at least, the work with this crop may as well be discontinued.

The yield of the varieties is shown in the following table:

ROWS OF PARSNIPS AND KOHL RABI EIGHTEEN INCHES APART, CARROTS, SIXTEEN INCHES, ALL OTHERS TWO FEET.

Varieties.	Names.	Length of row in feet.	Time of planting.	Yield of plot in bushels.	Yield per acre in bushels.
Rutabagas	Monarch or Tankard	360	May 20	18	1,089
"	Perfection White Swede	300	" 20	12	871.20
"	Shepherd's Golden Globe	100	" 20	5¼	1,143.45
"	Imp. Purple Top Yellow	100	" 20	6½	1,415.70
Turnips	White Egg	300	" 20	9	653.40
"	Extra Early White Milan	300	" 20	10	726
"	Cow Horn	155	" 20	9	1,264.64
"	Amber Globe (Isbell & Co.)	300	" 20	16	1,161.60
"	Large Amber Globe (D. M. Ferry)	300	" 20	15	1,089
"	Orange Jelly or Robertson's Golden Ball	300	" 20	13¾	998.25
"	Purple Top White Globe	300	" 20	14	1,016.40
Carrots	Guerande or Ox Heart	255	" 19	5¼	672.61
"	Chantenay	252	" 19	5½	712.85
"	Early Scarlet Horn	249	" 19	5	656.02
"	Nantes Half Long Early	252	" 19	5¼	680.62
"	Earliest Short Horn	249	" 19	4¾	623.22
"	Maud S	252	" 19	8¾	1,134.37
Stock Beets	French White Sugar	560	" 20	23	894.53
"	French Yellow Sugar	135	" 20	5½	887.33
Mangels	Imp. Mammoth Long Red	520	" 20	19	791.96
"	Orange Globe	520	" 20	19½	816.75
"	Yellow Leviathan	280	" 20	9½	738.96
Kohl Rabi	Early White Vienna	100	" 23	3	871.20
"	Early Purple Vienna	100	" 23	3¼	943.80
Parsnips	Hollow Crown or Guernsey	258	" 19	5½	619.06
"	Long White Dutch or Sugar	256	" 19	5¼	595.54
Table Beets	Edmand's Early Blood Turnip	270	" 20	3½	282.33
"	Extra Early Egyptian Blood Turnip	270	" 20	3¾	302.50
"	Crosby's Egyptian	266	" 20	3¼	266.10
"	Imp. Long Dark Blood	264	" 19	5½	453.75
"	Early Eclipse	262	" 19	3½	290.95
"	Chicago Market	260	" 19	3¾	314.13

GARDEN VARIETIES—PEAS IN 1905.

The planting of the varieties was unavoidably delayed, though none could have been safely planted as early as during former years, owing to the backwardness of the season. When the picking season of the late varieties was nearly over, the effect of late planting became manifest by an outbreak of powdery mildew which favored by hot and dry weather attacked all vines which were not fully ripened. As a consequence, the vines of late varieties which were left unpicked, did not ripen their seed pods as well as during former seasons, thus suggesting that inasmuch as planting during certain seasons may be delayed for various reasons, the early varieties are by far the safest for the purpose of raising seed. This suggestion is made while recognizing that the average for growing seed peas in the Upper Peninsula is increasing very rapidly each year and will likely increase still more if the use of varieties will be confined to such as ripen their seed before the advent of hot weather.

For quality the wrinkled sorts are the best and are also the most prolific. This applies to the earliest, such as *American Wonder*, and more so to the late varieties, such as *Telephone*, which may well be

taken as a standard for excellence. *Duke of Albany* and *Admiral Dewey* are practically as good, but aside from their different names, it is hardly possible to distinguish them from Telephone. *Telegraph* proved to be the latest variety. The peas are large but somewhat smaller than Telephone and their quality is nearly as good. *Hosford's Market Garden* is one of the best and also one of the most prolific of the late varieties, being of edible size nearly a week before Telegraph. *Pride of the Market* is somewhat less prolific and their flavor is nearly as good. Their stout and much shorter vines need but little support. Although classed as an extra early and being first in blossom, *Gradus* in this test was even later than Telephone. The peas are very large and of good quality, but not very prolific.

A further description of the varieties will be found in the following table:

Varieties.	Time of planting.	Time of blossoming.	When edible.	Length of vines in inches.	Length of pods in inches.	Number of pods per vine.	Number of peas in pods.	Quality.
Alaska	May 23	July 2	July 24	42	2¾	8–12	5–6	Fair.
Nott's Excelsior	May 24	July 3	July 24	24	2½	10–14	5–6	Good.
Monarch of Earlies	May 22	July 2	July 24	44	2¼	8–12	4–6	Fair.
First and Best	May 22	July 1	July 24	48	2½	8–12	5–6	Good.
Gregory's Surprise	May 19	July 2	July 20	45	2½	6–8	5–6	Fair.
American Wonder	May 22	July 4	July 24	16	2½	8–12	4–6	Good.
McLean's Little Gem	May 22	July 6	Aug. 1	40	2¾	10 14	6–7	Good.
Gradus	May 19	June 30	Aug. 7	38	3½	6–10	4–6	Good.
Telephone	May 19	July 11	Aug. 3	74	4	16–22	6–8	Very good.
Hosford's Market Garden	May 19	July 14	Aug. 11	46	3½	14–18	5–8	Good.
Pride of the Market	May 19	July 15	Aug. 11	28	3¾	12–16	5–8	Good.
Duke of Albany	May 22	July 12	Aug. 3	78	4	14–18	6–8	Very good.
Admiral Dewey	May 24	July 14	Aug. 4	70	4	12–16	7–9	Very good.
Champion of England	May 24	July 14	Aug. 17	74	3¼	12–16	5–7	Good.
Telegraph	May 19	July 13	Aug. 17	72	3½	18–24	6–8	Good.

GARDEN BEANS IN 1906.

Except as to the three hereafter described, the varieties planted were the same as those which were tested in 1905 when enough seed was saved from the ripe vines. The planting was done May 15, and the blossoming and other seasonable data was correspondingly earlier than in 1905 by from five to ten days. The results otherwise were practically the same, hence the foregoing table will fully answer as reference for both seasons. The powdery mildew started earlier and was more abundant, though it is not likely that this was due to earlier planting, but rather to a similarity of the weather conditions. This disease can be controlled by spraying and probably would have been checked if the spraying outfit had arrived earlier in the season. The other varieties tested are: *McLean's Advancer*, which blossomed July 2 and was of edible size July 28. The vines are 3½ feet hence need some support. The pods average 2½ inches and contain 5 to 7 large peas of good flavor and sweet. *Duke of York* is of the Telephone type, blossomed June 30 and is about a week earlier. In quality it is somewhat better than Gradus which it follows, but is not as good as Telephone. *Witham Wonder* is a most excellent variety with short vines averaging 2½ feet, pods 2½ inches, containing 5 to 7 large and sweet peas with a rich and spicy flavor. Quite prolific and was in season from July 21 to August 14.

GARDEN BEANS IN 1905.

Earlier planting not only gave better results generally, but vines of each, even including the Pole varieties, which were left unpicked, ripened the seed perfectly, though the ripe pods of the Pole varieties were confined to those within about 18 inches from the surface, while those higher up were far enough advanced for shelling: *Dwarf Siera* is the first Lima bean which has given favorable results here. Eighty per cent of the pods gave beans of edible size, and 20 per cent from the unpicked vines ripened the seed perfectly. With the exceptions hereafter noted, the vines and pods of the varieties were seriously affected by rust, the damage extending from 30 per cent for Currie's Rust Proof to nearly 70 per cent for Challenge Dwarf Black. Conspicuous among the exceptions, stands *Mexican Chile Carne*, which although surrounded by the worst infected vines, showed no sign of rust. This and the fact that over one-half of the pods were perfectly ripened before September 10, ought to recommend this as the most valuable variety which has been tested here. Their rapid growth suggested that the beans are chiefly adapted for shelling, and they were exclusively tested as such. When full grown the beans are white, of large size and excellent flavor. As they ripen, the color changes from yellow shades to light brown. *Bush Multiflora* was also conspicuous for its freedom from rust. The variety is Phascolous Multiflorus, a bush form of the old White Dutch Runner; though occasionally some plants have tendrils 4 to 6 feet long. Although late, the variety is fit for shelling a few days earlier than the Scarlet Runner. The large clusters of blossoms are quite ornamental. The beans are pure white, extremely large and of most excellent flavor. About 25 per cent of the pods ripened the seed perfectly.

Neither the Lima nor any of the Pole varieties were affected by rust. *Earliest Giant Advance* is the earliest pole bean tested here, and as such will prove valuable. *White Crease Back* is practically as early and is extremely prolific. The pods were fit for snap beans from August 21 to the end of September, and their quality is excellent. *London Horticultural,* claimed to be a dwarf, proved to be the Pole variety which is too late for successful planting in this latitude. In this test approximately one-third of the pods were far enough advanced for shelling and quite a few of the lower pods ripened the seed. Aside from being very ornamental, the *Two Colored Fire Bean,* which is a late Pole variety, furnished a shell bean of excellent quality and very large size.

A further description of the varieties will be found in the following table:

48

Varieties.	Time of planting.	Time of blossoming.	When edible.	Height of bush in inches.	Length of pods in inches.	Condition of pods.
Extra Early Round Pod Red Valentine	May 26	July 17	Aug. 15	14	4	Narrow, ½ round while stringless, later stingy when round, slightly curved.
Best of All	May 26	July 17	Sept. 4	14	4½	Broad, straight, partly splashed red.
Improved Goddard	May 26	July 17	Sept. 1	14	5	Broad, straight, many red splashes.
Extra Early Refugee	May 26	July 16	Aug. 17	9	4	Green, narrow, ½ round, partly stringless, slightly curved.
Early Mohawk	May 26	July 14	Aug. 7	12	4¾	Green, narrow, flat, straight, partly stringless.
Currie's Rust Proof	May 26	July 15	Aug. 7	15	4¾	Flat, straight, partly stringless.
Pencil Pod Wax	May 26	July 17	Aug. 8	12	4	Round, stringless, mostly curved.
Challenge Dwarf Black Wax	May 26	July 14	Aug. 3	8	3½	Flat, stringless, mostly straight.
Mexican Chile Carne	May 27	July 14	Aug. 25	15	6	Medium, broad, flat, straight.
Bush Multiflora	May 27	July 17	Aug. 28	12	4	Straight, broad, fleshy.
Dwarf Sieva (Lima)	May 27	Aug. 7	Sept. 25	14	3	Straight, flat, broad.
London Horticultural (Pole)	May 25	July 20	Sept. 4	80	4½	Straight, broad, splashed with red.
White Crease Back (Pole)	May 29	July 25	Aug. 21	96	5	Straight, narrow, almost stringless.
Earliest Giant Advance (Pole)	May 27	July 28	Aug. 20	84	7½	Broad, straight, nearly stringless.
Giant Scarlet Runner (Pole)	May 27	July 16	Sept. 1	108	7	Broad, nearly straight.
Two Colored Fire Bean (Pole)	May 27	July 13	Sept. 3	108	5	Broad, slightly curved.

GARDEN BEANS IN 1906.

Aside from those hereafter described, the varieties tested in 1906 were all those which are included in the foregoing table and were planted with seed which ripened here in 1905. The planting was done June 1 and 2, or 4 to 6 days later, though the blossoming and subsequent stages of development were one to four days earlier, probably owing to the dryer weather in July. As all other data are practically identical the foregoing table will serve as reference for both seasons. As stated under the head of Field Beans, the roots of about one-quarter of the plants were found provided with nodules for the first time, the largest and most numerous being found upon those of the Mexican Chile Carne variety. The annual investigations which have been made during the past six years have been so extensive and so thorough, that this sudden inoculation becomes all the more mysterious, and an explanation is not offered because none would be possible. The seed beans become frequently inoculated when grown upon soil which already contains the bacteria, yet this could not have been the case here, since the home-grown seed was used. Inoculation by natural drainage from the plots of field beans which had been artificially inoculated earlier in the season was practically impossible, owing to the rolling surface of the intervening ground and to the distance which was over twenty rods from the nearest south and over thirty rods to the nearest on the north side. Rust was fully as abundant as during the preceding season, and as usual, when the disease is prevalent, affected the wax varieties most and rendered the pods of some of these unfit for use before the picking season was half over. Of the many of these varieties which have been tested up to the present time, none has been found capable of resisting the disease except the *Golden Eyed Wax*, which is one of the varieties tested for the first time. The vines are 11 inches, the pods 4½, straight, broad, flat, stringless. Blossomed July 13, edible August 4, ripe September 10. Beans white with large splashes of dark yellow around the

eye. *Improved Golden Wax* blossomed July 13, edible August 1 and ripe September 20. Beans white, mostly covered with violet blue splashes. Vines 14 and pods 4 inches, straight, medium broad, flat, stringless. All rusted before the picking season was over. *Vienna Forced*, vines 9 inches, pods 4, light green, straight, flat, narrow, stringless. About 10 per cent rusted. Blossomed July 13, edible July 30, ripe September 8. Beans white with small light brown splashes around the eye. *Ne Plus Ultra*, the earliest of all varieties tested: Vines 10 inches, pods 4½, light green, narrow, slightly rounded, straight, stringless. About 15 per cent rusted. Blossomed July 12, edible July 27 and ripe September 5. Beans oblong, light brown with white eyes. *Green Seeded Flageolet*, vines 11 and pods 4 inches, dark green, narrow, half-round, partly curved, and stringless when picked early. Blossomed July 15, edible August 6 and ripe September 25. Beans oblong and pale green. The variety seems well adapted for canning. None rusted. *Norway*, a conventional name given to a variety, the seed of which was kindly donated by John B. Love, of Romeo (Mich.), who stated that the beans were secured a few years ago from an emigrant who brought them from Norway. This is a Pole variety of the wax type, and the vines are quite hardy but rust as bad as the bush varieties. They are very prolific with pods 6 inches long, broad, flat and stringless. The pods started to rust when the picking season was about two-thirds over, and all were rusted on September 20 when most of the beans were ripe. Blossomed July 23 and was edible August 16, the ripe beans being medium size and with a deep violet blue color. *Earliest Giant Advance* held out the promise it gave during the first test in 1905, this being the earliest Pole bean tested so far and ripening as early as some of the medium early bush varieties. None rusted and most of the pods were ripe September 10, the beans being medium large size, flat and pure white. *New Wonder* is a bush Lima bean of large size and tested for the first time. The vines are 18 inches, very stout, and the pods 3¼ inches and an inch wide. Blossomed July 28 and a few pods had beans of edible size September 5, but none ripened well enough for seed, nor did any of the *Dwarf Siera*, which was planted with seed which ripened here during the preceding season, though this was probably due to cutworms rather than to any other cause, for the rows of both varieties were on the outside of the bean plot, and the stalks of nearly every plant which was not destroyed was damaged more or less close above ground and more still below the surface.

SWEET CORN IN 1905.

Aside from being due to earlier planting and to more favorable weather during late summer, the better results may be ascribed to the more exclusive selection of dwarf varieties. Until certain varieties will become acclimated by selection or breeding, these dwarf varieties will be found decidedly better adapted to present climatic conditions, for in the sweet as in the field varieties, small ears generally means earlier ripening, owing to the smaller amount of water which must be evaporated during the ripening process. For quality, some of the dwarf varieties are much superior to the large early varieties and compare favorably with some of the best of the medium late sorts. For produc-

tiveness, they outrank all others, for their size permits them to be planted closer, while the stalks have never less than two and frequently three or four well developed ears. *Malakof* is the earliest and one of the best of the dwarf varieties, having been introduced from Russia a few years ago by Prof. N. E. Hansen of the South Dakota Experiment Station. *White Mexican* is somewhat larger and ripens early. The kernels are cream colored and sweet. *Early June* is smaller, of good quality and ripens as early. *Peep O'Day* followed next. Its quality is practically as good and the ears ripened better than they did during the preceding season. *Golden Bantam* is the latest of the dwarfs. The kernels are small, golden yellow and very sweet. *Queen of Earlies* was the earliest of the large varieties. The kernels are very large, cream color but not very sweet. *Oakview Early Market* ripened as early and the quality is much better. Approximately one-third of the ears of *Early Dakota* and of *Crosby's Early* became of edible size and only about ten per cent of *Banana Cream*. All three are of good quality but too late for profitable planting except under more favorable conditions than those which prevail at the station.

A further description of the varieties is given in the following table:

Varieties.	Time of planting.	Time of tasseling.	Time of silking.	When edible.	Height of stalks in feet.	Length of ears in inches.	Number of rows of kernels per ear
Malakof	May 25	July 26	Aug. 4	Aug. 28	4	5	8-10
White Mexican	May 25	July 28	Aug. 7	Aug. 30	4	6	8-12
Early June	May 25	July 26	Aug. 5	Aug. 31	4	5	8
Peep O'Day	May 25	July 27	Aug. 8	Sept. 2	4	5	8
Golden Bantam	May 25	Aug. 7	Aug. 16	Sept. 12	4½	6½	8
Queen of Earlies	May 25	July 28	Aug. 10	Aug. 30	5	7	8-10
Crosby's Early	May 28	Aug. 4	Aug. 18	Sept. 20	6	6½	12
Oakview Early Market	May 28	July 30	Aug. 10	Aug. 31	5	7	10
Early Dakota	May 25	Aug. 10	Aug. 20	Sept. 25	6	8	12
Banana Cream	May 25	Aug. 17	Aug. 27	Oct. 4	6½	7½	14-18

SWEET CORN IN 1906.

Lack of room permitted the testing of only five of the varieties which ripened during the preceding season, and to these was added the variety hereafter described. Those from home-grown seed were Malakof, Oakview, White Mexican, Queen of Earlies and Peep O'Day. They were planted May 29, or one to four days later, while the tasseling and subsequent stages of development ranged from one to eight days earlier. As in the case of the field varieties, the ears ripened better and earlier. *Holden*, a conventional name for the variety tested for the first time, is from seed kindly donated by L. C. Holden, of Sault Ste. Marie. This is a medium early variety, the season being about the same as Oakview. The stalks were 5½ feet, the ears 6 inches and eight rowed. Tasseled July 30, silked August 6 and was edible August 27. The kernels are golden yellow, very tender and sugary with a rich creamy flavor. The ears are fairly large and the kernels when ripe are deep amber color. About one-third of the unpicked ears failed to ripen properly, and here again was emphasized the importance of using home-grown seed, for ordinarily these smaller ears should have ripened quicker than the much

larger ears of Oakview, yet the ears of the latter variety were ripe long before the close of the season.

CUCUMBERS AND SUNDRY VINES IN 1905.

The vines as all other crops were about a week later than usual, owing to the backward season, but the fruit set abundantly, owing to the favorable weather which prevailed from the time the varieties began to blossom until the close of the season. Insects or diseases have never been troublesome, though cutworms, which are still abundant, destroyed many hills, especially on ground which was not fall plowed. Owing to the scarcity of room, only two to four hills of each variety were planted. The fruit of the pickling varieties of cucumbers was collected much smaller than the size limited in commercial growing, and in the following table the rate is figured at 750 pickles per bushel. The varieties were planted June 8 in rows 6 feet apart with the hills 5 feet apart in the row. The plot was on a south slope where high winds damaged the vines considerably. *Early Short Green* is the most profitable of the pickling varieties, and the fruit, while small, will become large enough for slicing. For pickling, the fruit is somewhat larger than the others which were tested, being prominently ribbed, pointed towards blossom end, light green; spines few, black, prominent. *Early Cluster* is essentially a pickling variety, the fruit setting in large clusters. The pickles are short, oblong, angular, light green, the spines few, large and black. *Earliest of All* is of the same type, the fruit being short, slightly tapering, light green with small numerous spines. *Early White Spine* sets fruit mostly in clusters, the pickles being short, tapering, dark shading to light green at blossom end, with large and prominent spines. More or less fruit set after September 12 when the vines were slightly damaged by frost, but no account was kept of it.

The actual and comparative yield is shown in the following table:

Date of Picking.	Early Short Green. (4 Hills.)	Early Cluster. (3 Hills.)	Early Russian. (4 Hills.)	Earliest of All. (3 Hills.)	XXX Pickling. (4 Hills.)	Early White Spine. (3 Hills.)
August 14	38	9	30	42	6	....
" 18	73	36	63	43	37	27
" 21	39	43	45	22	27	21
" 25	64	30	27	36	65	21
" 29	103	52	69	34	73	43
September 2	41	32	39	35	57	26
" 5	55	46	57	37	67	22
" 11	104	62	62	41	47	32
Total	507	310	392	290	379	192
Yield per acre in bushels	245.38	200.06	189.86	187.14	183.43	123.77

Two varieties better adapted for slicing were tested, *Improved Long Green* being the earliest of the two. The fruit is slender, 6 to 8 inches long, dark green, the spines few, prominent, black. *Arlington White Spine* is a week later. The fruit is oblong, tapering, 5 to 7 inches long,

dark green shading to straw color at blossom end. Spines few, very small white.

The squashes and pumpkins were planted June 7 and 8. *Mammoth Summer Crookneck, Straightneck, Early Yellow Bush Scallop* and *White Bush Scallop* ripened every fruit and have not much to recommend them except their earliness. The late varieties are much superior, and the *Hubbard*, which may be taken as a standard for good quality, ripened well enough to keep in an ordinary cellar until the latter part of January. *Delicious* is one of the most valuable varieties tested. In color of skin and flesh it resembles the Hubbard very much, being somewhat lighter colored and smooth-skinned. In size it is smaller; in quality it is nearly as good, and it has the advantage of being fit to use before being fully ripe. *Vegetable Marrow* is a medium early variety of fair quality. The fruit is of good size, averaging about 10 inches in length and 5 inches in diameter, cylindrical, smooth, pale yellow, with hard but very thin shell.

Of the pumpkins, *Sugar* or *New England Pie* is the same variety tested heretofore as Sugar Pie. The fruit while small is thick fleshed, of excellent quality, very hardy and ripens early. *Winter Luxury* is nearly as early and somewhat larger size but thinner fleshed. Sweet, with more pronounced pumpkin flavor but of good quality. *Large Sweet Mammoth Pie* has short vines, being partly bush form. The fruit is large, cylindrical, of good quality but ripens rather late.

Of the two varieties of Muskmelons tested *Extra Early Citron* ripened nearly all its fruit and *Earliest Ripe* about one-half. Both are green-fleshed and fairly sweet. *Colorado Preserving* and *Citron Melon* are varieties used for preserves, and the vines are quite hardy. They blossom late, but the large globular-shaped fruit ripens promptly and is not damaged if exposed to light frosts.

Onions.—The varieties were mostly destroyed by the onion maggot, which seems to have come to stay. Assuming that those from seed might escape if planted at some considerable distance from the sets, the latter varieties were planted upon adjoining ground which had been in onions during the preceding season, while the seed was planted upon a plot about 600 feet distant where no onions have ever grown. The plants were hardly large enough for thinning out when the maggots began their work. The *White Welsh*, a variety exclusively used for bunching, was not damaged, nor was the *Egyptian*, a somewhat coarser variety used for the same purpose. Of the others, *Queen*, an early, white and flat-shaped variety, is the only one which ripened quite a few large bulbs which were not damaged. This being no doubt due to the more rapid growth of the bulbs would suggest that better results might be obtained from fall planting experiments which it is hoped to begin during the next season.

Tomatoes.—Approximately 75 per cent of the fruit ripened, and while the better results are mainly due to the favorable weather of late summer, the fact that all side shoots were pinched off throughout the season and the plants thus trained to single stems, was no doubt of material assistance in hastening the ripening of the fruit by the freer admission of direct sunshine. What the plants thus lost in width they gained in height, for the 3-foot stakes to which they were tied had to be replaced by 5-foot stakes before the end of July, and at the beginning of Sep-

tember all plants had reached a height of 5 to 6 feet. The varieties tested were *Earlibell*, a nearly smooth variety of large size and good keeping qualities, the others being *Earliest of All*, *Nolte's Earliest* and *Atlantic Prize* which have been previously tested. For two seasons, the seed from the earliest fruit of smooth shape of the Earliest of All variety has been saved for replanting in the hope of developing an earlier strain. Thus far the hope has not been realized, and Atlantic Prize is still the earliest of any varieties tested, though the fruit of Earliest of All from which the seed had been saved had ripened during the preceding season six days before Atlantic Prize. The small varieties which are used for preserves generally ripen well; the *Red Currant* somewhat the best for being the earliest, and the *Yellow Plum* having considerable partly ripened fruit at the close of the season, for being the latest variety.

Radishes.—The growth of the varieties planted May 13 was slow, and as a consequence more or less roots were damaged by maggots. Later plantings gave better results. *Twenty Day Forcing* was first in reaching edible size June 18. The roots are small, oblong with abrupt terminating tap-root, deep scarlet and comparatively large tops. *All Seasons*, planted June 9, was of edible size July 11. The roots are turnip-shaped with long abrupt terminating tap root, light crimson, juicy, very mild. Tops large; leaf stems red. *Prussian Globe* is a small, deep crimson, globe-shaped forcing variety of good quality. *Early Golden Yellow Oval* is an early yellow-skinned variety with white flesh, mild and juicy. Those true to name are oval with small abrupt terminating tap-root. The seed was mixed. *Improved Chartiers or Shepherd* is early, of large size, cylindrical, 5 to 6 inches long and growing partly above ground. Dark crimson, juicy and somewhat pungent. *Celestial* is a medium late variety of large size. Oblong with long tapering tap-root. White, very juicy, mild.

Spinach.—*Viroflay* is the best of the varieties tested. The leaves are very large, dark green, pointed and half blistered. *Norfolk Savoy* is the next best, the leaves being large, blistered and dark green. *Victoria* is the best of the smooth-leaved varieties, the leaves being large, rounded and tender.

Lettuce.—The varieties planted June 9 matured August 25 to 30. *California Cream Butter* is a large heading variety. The leaves are pale green, round, slightly blistered, partly splashed or fringed with red at edges. *Brown Dutch* forms medium sized heads with round, blistered leaves of dark green color partially overlaid with coppery red. *White Summer Cabbage* was the earliest. The heads are small but firm, the leaves pale green, round and blistered. *Silver Ball* is a later variety with larger but somewhat loose heads, the leaves being large, round, blistered and pale green. *Tilton's White Star* is an early open head variety with pale green, wavy and blistered leaves. *Early White Self Folding* is medium late with pale green, smooth and narrow leaves which fold loosely into pointed heads of Cos type.

Cabbage.—The plot, owing to lack of room, was laid out upon ground which has been partly drained but is too wet for fall or early spring plowing in its present condition. The soil is a muck of fair quality, had never been plowed and was covered with a heavy sod of volunteer tame grasses. Owing to the moist and at times wet condition of the

soil, the sod decomposed very slowly and the resulting heat together with the high temperature of late summer induced a growth of loose-headed or undersized heads, the early varieties faring worse than the late sorts. *Marblehead Mammoth Drumhead*, a late fall variety, produced large, firm heads of flat shape with pale green leaves. *Jackson Winter* formed round and slightly flattened solid heads of medium size with outside leaves dark green and central leaves with pink-colored edges. *Hollander Danish Ballhead* formed medium-sized, firm heads of globular shape, with bluish green leaves and the ribs of outside leaves partly tinged red on under side. *Improved American Savoy* is of excellent quality. The heads are medium to large size, firm and nearly globe shaped.

Celery.—The plot was in celery during the preceding season and was alongside of the cabbage plot. *White Plume*, *Giant Golden Heart* and *Perle La Grande*, in the order named, were partial failures owing to many plants running to seed. Of the three, Giant Golden Heart is the best as an early fall variety. The stalks blanch promptly, average nearly two feet high and have an excellent flavor. Perle La Grande is a week to ten days later, is of large size and fair quality. *Meyer's Quick Growing* is a smaller variety which has not much to recommend it except its extreme earliness, the plants maturing about August 10.

Pepper.—Large Bell or Blue Nose. The plants were set out June 17 and blossomed July 12, ripening most of the fruit which is borne profusely, is of large size and mild flavor. The partly ripened fruit is well adapted for pickling.

Tobacco.—Plants of the *Sterling* variety were set out June 17, blossomed August 15 and ripened most of their seed. Those which were kept from running to seed produced large leaves which average 30x17 inches.

Kale.—The varieties tested, while as coarse, are much better than those heretofore tested, being freer from bitter taste when full grown. *Drumhead* is the best in this respect. The leaves are dark green, much crimped with wavy, greenish white margins and fold into loose heads. *Siberian German Greens or Sprouts* forms low, spreading plants with small dark green leaves, much cut and partly crimped. Like others of this kind, these varieties are extremely hardy.

HERBS, HONEY PLANTS AND ORNAMENTALS.

As space permits, a few of these are tested each year for the purpose of securing a list of the hardy varieties which are adapted to this latitude. The following herbs were found very hardy: *Summer Savory* (Satureia hortensis, Linn.) Plants 18 inches high, much branched with oblong linear leaves tapering at base and numerous clusters of purplish small flowers. Blossomed August 14. *Sweet Marjoram* (Origanum Majorana, Linn.) Leaves small and finely soft downy. The plants were 8 inches high and did not blossom, owing to late planting. *Thyme* (Thymus Serby linur (Linn.). Stout, but low and almost creeping plants with very small dark green leaves. *Sage, English Broad Leaf* (*). Plants fairly stout and branching; the leaves used for seasoning. *Tarragon* (*). Plants 28 inches high, stout, branching. Leaves narrow,

* Variety undetermined.

lanceolate, sweet scented. Used for flavoring vinegar and pickles. *Wormwood* (Artemisia Abrotanum, Linn.). Plants 2½ feet high, woody stemmed. Cultivated as "Southernwood" for the pleasant-scented foliage. *Catnip* (Nepeta Cataria, Linn.). Plants with strong fragrance. Soft downy; leaves oblong, heart-shaped; clusters or spikes of small whitish flowers in late summer. Sometimes used in medicine. Elsewhere a weed around dwellings or gardens. *Basil* (Ocimum Basilicum, Linn.). A sweet herb forming plants 12 inches high with light green, orate and somewhat toothed leaves and bluish white racemed flowers in late summer. Not quite as hardy as the others.

Among the Honey Plants tested, Anchusa Italica, Retz. planted in 1903 is still the favorite of honey gathering insects. The plants were loaded with the showy small blossoms from June 2 until permanent snow fell. *Borage*, planted in 1904, is more or less self-seeding. Voluntary plants blossomed July 12. Those from spring planted seed July 30. *Phacelia (Viscida Torr.)* blossomed July 19; the deep blue flowers being an inch in diameter. Plants rather coarse, clammy. Leaves ovate, cut-toothed with dark pink margins. *Phacelia Whitlavia* (Whitlavia Grandiflora) blossomed July 27, resembles the last in growth and foliage. Is less clammy and more spreading. Leaves solid green, coarsely toothed, roundish ovate and on longer petioles. Flowers violet blue with stamens and style slender and protruding. *Alyssum Maritimum, Lam.* (Sweet Alyssum) blossomed July 20. The dwarf plants were covered until the end of the season with masses of showy, small, white, honey-scented flowers. *Centaurea Cyanus Linn.* (Cornflower, Bachelor's Button). Flowers large, blue, on solitary long-stalked head. Stems loosely cottony. Occasionally running wild. *Cleome Pungens* proved to be *Cleome integrifolia*, blossomed August 6. Plants stout, smooth, 2½ feet high; the numerous pink flowers lasting until the close of the season. Cultivated for bees as "Rocky Mountain Bee Plant." *Mignonette*. (Reseda Odorata Linn.) The well-known and delicious-scented flowers lasted from August 9 until the forepart of November. *Stock*, German Ten Weeks (Matthiola amma, sweet) proved to be *Malcolmia Martima, Br.* (Mahon Stock), blossomed August 26. Plants 18 inches high, with oblong or spatulate, pale green leaves and numerous flowers 1½ inch in diameter, white in one variety, and in the other pink changing to violet purple.

Nigella Damascena Linn. (Love in a Mist) blossomed August 15. Large bluish flowers surrounded and overtopped by a finely divided, leafy involucre, and succeeded by a smooth, inflated 5-celled seed pod.

Eschscholtzia Californica, Cham. (Californian Poppy). The large, bright orange yellow flowers lasted from July 26 until November.

Pansy (Viola Tricolar Linn.). Plants of the best large flowering varieties, kindly donated by R. C. Bradley, of Newberry, were set out in 1904 and furnished the earliest flowers of the season, the plants beginning to blossom April 30 and continuing until November.

Bulbs of several fine varieties of *Dahlias* and *Cannas* were kindly donated by C. V. R. Townsend, of Negaunee. The plants were cut back several times by cutworms, but finally recovered, the Dahlias blossoming from August 8 until the middle of October. The Cannas did not blossom until September 14, the very large and ornamental leaves being quite as handsome as the tall spikes of bright flowers. Planted June 12,

the *Tall Nasturtiums* blossomed July 6 and the Dwarfs August 5, the large, many-colored flowers lasting until the middle of October.

Nasturtium, Queen of Tom Thumbs, planted on same day, blossomed August 10. The plants are quite dwarf but very ornamental. Leaves small, pale green, splashed with white, and flowers large with a velvety golden brown color.

STRAWBERRIES.

Among small fruits, the tests were confined to strawberries; those with bush fruits having been discontinued with the intention of taking them up again when the wet area upon which the varieties were located will be tile drained, or when additional ground will be cleared up upon higher and naturally drained ground.

The varieties tested are those which fruited during the previous two seasons and to which have been added those which have been removed from the wet ground where they have been formerly located. While the yield was large, most of the varieties did not come up to the large yield of the preceding season. The shortage was due partly to the hot, dry weather in July, which shortened the picking season and reduced the size of the fruit, and partly to a greater prevalence of rust which might have been counteracted had the plants been sprayed as good practice demands. Those which yielded more than they did during the preceding season, did so on account of their greater immunity from rust, the stout plants of *Sample* being conspicuous in this respect. The rows which fruited since 1903 were thinned out when the picking season was over and will be allowed to bear another year. Up to the present time, lack of room has not permitted the testing of different cultural methods, and the plants have been growing in matted rows, a system which perhaps is cheapest but by no means the best. Each variety occupies a row ninety feet long, the rows being four feet apart when the plants are set out.

The yields are shown in the following table:

Varieties.	Sex.	First blossom.	First ripe fruit.	Last ripe fruit.	Yield of plot in quarts.	Yield per acre in quarts.
Excelsior	Perfect	May 20	June 22	July 18	37½	4,537½
Bederwood	Perfect	" 20	" 24	" 20	60	7,562½
Mayflower	Perfect	" 21	" 23	" 14	24	2,904
Oregon Iron Clad	Perfect	" 25	" 24	" 18	15¼	1,845¼
Success	Perfect	" 29	" 25	" 24	21	2,541
Mexican Everbearing	Perfect	June 2	" 26	" 15	27½	3,327½
Seaford	Imperfect	May 30	" 28	" 20	17¾	2,147¾
Bryant	Perfect	" 29	July 2	" 24	35	4,235¾
Texas	Perfect	June 3	" 3	" 18	15	1,815¾
Bubach	Imperfect	" 2	" 3	" 24	38	4,598¾
Clyde	Perfect	May 27	" 3	" 26	43¼	5,233¼
Haverland	Imperfect	" 23	" 4	" 20	57½	6,957½
Parker Earle	Perfect	" 23	" 5	" 24	36¼	4,386¼
Midnight	Perfect	June 2	" 5	" 15	2½	302½
Brandywine	Perfect	May 30	" 5	" 26	19	2,299¼
Sample	Imperfect	June 1	" 7	" 26	56½	6,836½
Glen Mary	Perfect	May 31	" 5	" 24	33½	4,053½
Marshall	Perfect	" 26	" 8	" 24	8¾	1,058¾
Gandy	Perfect	June 7	" 10	" 24	29½	3,569½
Michigan	Perfect	" 4	" 11	" 26	5¾	695¾

STRAWBERRIES IN 1906.

The low yields in 1906 are principally due to the fact that this was the fourth bearing season of most of the varieties, and that the damage from dry weather at ripening time was accordingly greater, for the plants being in matted rows, the difficulty in giving proper cultivation increases with the age of the rows. Cutworms did considerable damage and destroyed most of the plants on the outside rows of the later planted varieties. Those tested for the first time are: *Warfield* (Imperfect), one of the principal market varieties. Ripe June 28. Size medium to large, conical to wedge-shape. Color dark crimson; flesh firm and of excellent quality. Plants were badly rusted. *Kansas* (Imperfect). Ripe July 3. Size small to medium, conical to roundish with tip often ending in a depression. Color dark scarlet; flesh red, firm, juicy, mildly acid, good in flavor and quality. Plants strong but small. An excellent variety except for the short stems and the small size of the fruit. *Dunlap* (Perfect). Ripe June 28. Size medium to large, roundish conic or somewhat elongated and slightly necked. Color dark scarlet; flesh red, quite firm, mild, sprightly, of excellent quality and flavor. Plants rather too numerous, but very vigorous and productive. The fruit picks easily and is desirable owing to its attractiveness. On account of its many good qualities, this will no doubt become one of the most popular market varieties. *Wm. Bell* (Perfect). Ripe July 3. Size large to very large, wedge-shaped. Color dark scarlet; flesh red, firm, mild and of excellent quality. *Uncle Jim* (Perfect). Ripe July 5. Size large to very large, round conical to wedge-shape and often corrugated. Color bright crimson; flesh red, firm, very good.

The rows were 50 feet long, and, as during former seasons, the plants were mulched between the rows from the time the earliest fruit was about two-thirds full grown until the picking season was over; the mulch being thereafter removed and kept off until the following season. Earlier observations have shown that mulching in the winter time is a detriment rather than a benefit, and that under the prevailing climatic conditions, the snow constitutes the best and safest kind of a mulch. In order to observe the value of the mulch as a protection during frosty nights while the plants are in blossom, one-half of the row of Dunlap was covered towards evening of June 11 when a frost seemed eminent Though the frost was light, subsequent observations showed that about ten per cent of the blossoms of unprotected plants were damaged and that none of those of the covered plants had been injured.

As will be seen in the following table, this protection increased the yield by nearly 218 quarts per acre:

Varieties.	Sex.	First blossom.	First ripe fruit.	Last ripe fruit.	Yield of plot in quarts.	Yield per acre in quarts.
Excelsior	Perfect	May 25	June 27	July 14	5¾	1,252⅕
Bederwood	Perfect	" 24	" 28	" 20	7	1,524⅗
Mayflower	Perfect	" 26	" 28	" 12	3½	762 3-10
Oregon Iron Clad	Perfect	" 29	July 2	" 15	3	653 2-5
Success	Perfect	June 2	" 3	" 18	3½	762 3-10
Mexican Everbearing	Perfect	May 31	June 28	" 12	3	653 2-5
Seaford	Imperfect	June 2	July 3	" 18	3½	762 3-10
Bryant	Perfect	" 1	" 2	" 20	7½	1,633½
Texas	Perfect	" 3	" 3	" 12	2½	544½
Bubach	Imperfect	" 1	" 2	" 20	7½	1,633⅓
Clyde	Perfect	May 30	" 2	" 20	5½	1,197 9-10
Haverland	Imperfect	" 27	" 3	" 20	3	653 2-5
Parker Earle	Perfect	" 27	" 2	" 20	3½	762 3-10
Midnight	Perfect	June 1	" 3	" 18	2	435 3-5
Brandywine	Perfect	May 31	" 3	" 20	3½	762 3-10
Sample	Imperfect	June 2	" 2	" 20	5½	1 197 9-10
Glen Mary	Perfect	" 1	" 5	" 20	4	871⅕
Marshall	Perfect	" 1	June 28	" 12	2	435 3-5
Gandy	Perfect	" 3	July 5	" 20	3	653 2-5
Michigan	Perfect	" 4	" 8	" 20	1½	326 7-10
Dunlap, 25 feet	Perfect	May 31	June 28	" 18	5	2,178
Dunlap, 5 feet (Covered)	Perfect	" 31	" 28	" 18	5½	2,395 4-5

ORCHARD IN 1905.

The weather conditions of both winter and summer were favorable for orchard conditions and, as a consequence, some of the trees which came into bearing during the preceding season were well loaded with fruit. Many trees were maimed or destroyed by windstorms, for the orchard is unprotected in the direction of the prevailing winds, and as stated in previous reports, its location is such as to make the planting of a windbreak a necessity if best results are to be obtained. As usual, the aphis was the only insect which required attention. On the other hand it makes up for the absence of other species by its persistency and great numbers, and considering the very rapid growth of many trees and the fact that a small knapsack sprayer constitutes the station's entire spraying outfit, the lack of subduing this pest may well be considered an expensive one and one which hereafter will be well nigh impossible until the station will be provided with an outfit such as the teachings of horticulture claim to be indispensable in up-to-date orchard methods. A great many of the insects were destroyed by spraying at the time the buds began to open, this being the best time for controlling the first brood of this insect. The mixture which proved most effective during the past two seasons consists of one pound of laundry soap and one pound of tobacco stems for eight gallons of water. To be effective this mixture should be used the same day when made or not later than the next day. During an attempt to control the second brood the spraying was kept up for several days and finally given up when it was found impossible to control the insect with a small hand outfit without neglecting the spraying of potatoes altogether. Of diseases, none but the apple scab requires attention and not, however, for varieties which are practically immune, such as Hibernal, Duchess Yellow Transparent and several others. On the other hand most of the varieties will be a partial or complete failure unless properly sprayed. Thus several trees of the *Longfield* variety were loaded so heavy as to require thinning out and fully two-thirds of the fruit was rendered worthless

by scab. The tallest and most promising trees at blossoming time were those of the *Haas* variety, yet the attack of scab was so severe early in the season, that the fruit and many leaves fell off before the apples were one-quarter full grown, and none of the trees ripened more than three or four apples. Of *McIntosh Red* which is still more subject to scab, not an apple remained on any tree, nor more than one-half of the leaves. It will take some years before fruit growing in a timbered region will become an important factor, yet the time seems opportune for insisting that spraying is an absolute necessity, for the development of scab and other parasitic fungi is much more favored in a region with abundant moisture than it is wherever a lack of rainfall is the general rule. Furthermore the loss of fruit from unsprayed trees is only an incidental damage, for scab impairs the vitality of the leaves, hence the vitality of the tree by causing the season's growth of wood to ripen too late. Thus sunscald and the premature death of the trees are natural consequences, yet the man who fails to spray generally inflicts a greater injury upon others than he does upon himself, for he is usually the first to blame the climate or the Lord for his neglect, and in so doing he becomes the involuntary but no less pessimistic agent who injures his neighborhood and his state. The fact that the first ripe fruit of Duchess secured a bronze medal for this station at the St. Louis World's Fair, offers some assurance that apple growing in this region will sooner or later become an important factor, and to point the way towards success is the station's most important mission, which, however, can hardly be fulfilled except by practicing the same progressive methods which it feels in duty bound to preach to others.

The varieties which came into bearing for the first time are: *Longfield*. Tree of Russian origin and of spreading, pendulous growth, having all the appearances of a heavy bearer. Fruit medium size, roundish conical. Skin smooth, clear waxen yellow with a bright red blush. Dots distinct, few, large, yellowish. Cavity deep, narrow, russeted with short stem. Basin abrupt, narrow, wrinkled. Flesh clear white, tender, juicy, pleasant, brisk sub-acid, good. Season November. Blossomed June 6. *Wealthy*. Originated by the late Peter M. Gideon, of Excelsior, Minnesota. Tree vigorous and spreading. Fruit large, roundish oblate, regular. Skin smooth, light yellow, almost wholly covered with bright crimson stripes and splashes, marbled and mixed on sunny side. Dots numerous, minute, white. Cavity deep, acute, regular, slightly russeted with medium stem. Basin deep, smooth, regular, abrupt. Flesh white, sometimes stained with red, tender, very juicy, sprightly subacid, very good. Season February. Blossomed June 11. *Peter*. Tree of same origin as Wealthy and said to be hardier. Both are excellent and so nearly alike as to make any distinction very difficult. *Tetofsky*, origin Russia. Tree vigorous and very upright. Fruit medium, roundish oblate, somewhat conical, angular. Skin smooth, yellow, striped and splashed with bright crimson, marbled and mixed on sunny side and overlaid with whitish bloom. Cavity wide, regular with stem short to medium. Basin shallow, ribbed and corrugated. Flesh white, juicy, sprightly acid, good. Season September. Blossomed June 10. *Gideon*, same origin as Wealthy. Tree vigorous, slightly spreading. Fruit large, roundish oblong conical, regular, slighty ribbed. Skin clear yellowish white with faint bronze blush and frequently bright crimson on sunny

side. Dots white, numerous, minute. Cavity wide, deep with stem medium to long. Basin wide, shallow, corrugated. Flesh white, juicy, brisk subacid, good. Fruit has characteristic habit of beginning to decay at core. Season December. Blossomed June 6. *Charlamoff*, of Russian origin. Tree vigorous, spreading, bark when young a bright orange color and tree having a yellowish-green aspect. Fruit medium to large, oblong conical or roundish truncated. Skin greenish-yellow with red stripes and splashes. Dots white, minute. Cavity medium deep, slightly russeted with stem medium and slender. Basin wide, wrinkled. Flesh greenish white, tender, vinous acid, very good. Season October. Blossomed June 10. *Whitney* (Whitney No. 20) a Hybrid. Origin, Illinois. Tree stout, spreading. Fruit large to very large for a hybrid, roundish to oblate conic. Surface smooth, yellow with red stripes and splashes on sunny side. Flesh pale straw color, tender crisp, very juicy, mild subacid, without astringency and very good. Season September. Blossomed June 7. *Yellow Arcadian*. Trees planted in 1902. Was found to be identical with Hibernal which was planted in 1901 and came into bearing in 1904.

The varieties of plums and grapes did not ripen the fruit any better than during the preceding season.

King Karl and Triumph, two varieties of dwarf pears blossomed July 10 and July 12, respectively. The trees are quite hardy, but the late blossoming and the fact that the fruit at the close of the season was scarcely two-thirds full grown is ample evidence that the season is too short for these varieties. *Flemish Beauty*, a standard pear, blossomed June 7, but set no fruit, owing to an attack of scab which affects this variety much more severely than any other. As anticipated during the preceding season, the rest of the cherry trees were either dead at the beginning of the season or died soon thereafter. As with trees which previously died, the trouble in each instance was due to a dead portion of the stem extending not over two inches above and two inches below the point where the tree had been originally grafted, the entire tree above and the root system below being in a healthy condition. In each instance there was a sharp upward taper from the union, an extreme case being that of one of the largest trees which immediately above ground and 4 inches above the union measured 9½ inches in circumference, while 6 inches below the surface or 2 inches below the union, the circumference measured 14¾ inches. Experts to whom diseased trees were sent, expressed different opinions, and the true cause therefore remains unexplained. The sharp taper would indicate that a remedy might be found by grafting upon slower growing stock and the Pin Cherry (Prunus Pennsylvanica, Linn.) would suggest itself as adapted for this purpose. As against this stands the fact that the Pin Cherry is seldom if ever found in the neighborhood of the station or upon any of the other limestone soils of the southern slope of the Upper Peninsula, while it is found in great abundance on the sandy soils of the Potsdam formation on the northern slope. Likewise the varieties of Prunus Cerasus which have died here after a healthy growth and bearing one to three crops, are long lived wherever planted on the northern slope, thrifty trees 20 years or more old being found in Marquette, Baraga and other counties. Evidently trees as well as other plants have their likes and dislikes, for to cite two other examples: the black cherry

(Prunus Serotina, Ehrh.) is not found but very seldom or at best as a shrub on the northern slope, while in the neighborhood of the station or upon other limestone soils, this variety is found as a large-sized forest tree. The white flowering raspberry (Rubus Parviflorus, Nutt.), locally known as Thimbleberry, grows very thrifty and abundantly on the northern slope, yet is not found in this neighborhood or in other localities with similar soils. While advice is very frequently asked, the foregoing must stand as the station's only recommendation until new plantings may be made or grafting experiments be started.

ORCHARD IN 1906.

On the whole the weather conditions were favorable for fruit trees, though with the exception of the Wealthy variety, the apples set fruit quite sparingly. Plums were uniformly loaded heavy and the fruit ripened well. Of insects, the usual number of larvae of Basilarchia arthemis were found, and though they would yield readily to poisoning, the fact that the larvae comes out in search of food before the buds open and that robins are here even before the snow has entirely disappeared, makes it hardly possible for this insect to increase very much in numbers. For the first time there was an almost total absence of aphis, while on the other hand the first scale insect, identified by Prof. R. H. Pettit as Lecanium Canadense or Armeniacum, was found upon two plum trees during August, it having heretofore been found working only on young elm trees in the neighboring forest. Aside from apple and pear scab there was no fungous disease except a first appearance of plum pocket on two trees of the Weaver variety.

Plums.—The following plums ripened well for the first time: *De Soto*, origin Wisconsin. The trees are vigorous, very productive and have a tendency to over-bearing. Fruit nearly round with small pit and of good quality. A greyish bloom makes the color somewhat unattractive. Medium size, but rather small if not thinned when a heavy crop of fruit is set. *Weaver,* origin Iowa. Tree hardy, with open, spreading habit. Very productive, the fruit large, egg-shaped, inclined to become scabby and not of best quality. *Wolf*, origin Iowa. Tree hardy, round topped and fairly productive. Fruit large, firm, light red, seldom cracks and of good quality. *Hawkeye,* origin Iowa. Tree vigorous and quite productive. Fruit large, of fair quality, excellent color and keeps well. *Surprise*, origin Minnesota. An upright, handsome tree, lacks somewhat in hardiness and is not very productive. Fruit large, bright red, with thin skin and small pit, firm, sweet and of excellent quality, but cracks badly and ripens rather late. *Stoddard*, origin Iowa. Tree hardy, moderately spreading, productive but becomes weakened if allowed to overbear. When thinned the fruit is very large, roundish, of good appearance and quality. *Forest Garden*, origin Iowa. Tree quite hardy and fairly productive, much spreading, weak in the forks, hence inclined to split. Fruit medium to large size, of good color and excellent quality but cracks badly. *Wyant,* origin Iowa. Tree very hardy and abundantly productive. Fruit large and retains good size even with heavy crop; of good color and quality though skin is somewhat bitter. Of the varieties described, this is probably the most desirable. Of European varieties only Moore's Arctic and Shrop Damson have been tested so far; the

former, as related in a preceding bulletin, not having proven sufficiently hardy. *Shrop Damson* is moderately hardy, subject to sunscald, but bears a light crop each year. The small, dark blue plums are popular for canning but of poor quality. No Japanese varieties have been tested, and until results can be given, the beginner is cautioned against planting any except on a very small scale and then only in favored locations near the Lakes. The station's increasing correspondence shows that practically all failures elsewhere are due to the smooth tongue of the inexperienced tree agent and his "pretty pictures" of these varieties.

Apples.—The following varieties came into bearing: *McMahon,* origin Wisconsin. Tree quite hardy, moderately spreading and a strong grower. Fruit large to very large, roundish, somewhat conical, obscurely angular and irregular. Color greenish pale yellow becoming almost white when fully ripe, often with delicate blush on sunny side. Dots white, large, suffused. Cavity regular deep, acute, russeted. Stem medium short and stout. Basin narrow, wavy and medium deep. Flesh white, somewhat coarse-grained, crisp, juicy, sprightly subacid. A good table and cooking apple but not a first-class shipper, as the skin is tender and shows bruises readily. Blossomed June 5. Season October-December. *Pointed Pipka.* Blossomed June 3. Was found to be identical with Charlamoff. *Martha,* origin Minnesota. Size large for a crab, form oblate, color yellow with blush of light red and many light dots. Cavity medium wide and deep, russeted; stem long and slender. Basin shallow, partly wrinkled. Flesh yellowish, fine grained, firm, acid and fine for cooking. Tree vigorous, upright, scabs badly. Blossomed June 2. Season September and October.

MICHIGAN

STATE AGRICULTURAL SOCIETY

50

MICHIGAN STATE AGRICULTURAL SOCIETY.

REPORT OF THE TRANSACTIONS OF THE SOCIETY FOR THE YEAR 1906 AND PROCEEDINGS OF THE WINTER MEETING OF THE EXECUTIVE COMMITTEE.

OFFICERS FOR 1906-7.

President—Fred Postal, Detroit.
Vice-President—Stephen Baldwin, Detroit.
Secretary—I. H. Butterfield, Detroit.
Treasurer—John McKay, Romeo.

EXECUTIVE COMMITTEE.

Term ending January, 1907.

J. F. Brand	Saginaw, Saginaw County.
Jason Woodman	Paw Paw, Van Buren County.
A. E. Stevenson	Port Huron, St. Clair County.
C. A. Tyler	Nottawa, St. Joseph County.
W. E. Boyden	West Bay City, Bay County.
Wm. Dawson	Sanilac Center, Sanilac County.
J. E. Rice	Grand Rapids, Kent County.
Lawrence W. Snell,	Highland Park, Wayne County.
Geo. Kelly	North Branch, Lapeer County.
Geo. G. Winans	Hamburg, Livingston County.

Term ending January, 1908.

A. J. Doherty	Clare, Clare County.
W. J. Galbraith	Calumet, Houghton County.
Wm. J. Terney	Roscommon, Roscommon County.
Herbert E. Powell	Ionia, Ionia County.
F. B. Ransford	Caro, Tuscola County.
W. W. Collier	Pontiac, Oakland County.
L. R. Taft	Agricultural College, Ingham County.
George B. Horton	Fruit Ridge, Lenawee County.
D. D. Aitken	Flint, Genesee County.
B. E. Hall	Port Huron, St. Clair County.

EX-PRESIDENTS.

Members Ex-Officio.

T. W. Palmer..Detroit, Wayne County.
John T. Rich..Lapeer County, P. O. Detroit.
I. H. Butterfield..Detroit, Wayne County.
E. Howland..Pontiac, Oakland County.
Eugene Fifield..Bay City, Bay County.

STANDING COMMITTEES AND EXECUTIVE SUPERINTENDENTS.

Business—A. E. Stevenson, Lawrence W. Snell, I. H. Butterfield.
Finance—A. J. Doherty, Eugene Fifield, D. D. Aitken.
By-Laws and General Rules—W. J. Galbraith, W. E. Boyden, William Dawson.
Premium List—A. E. Stevenson, H. E. Powell, W. W. Collier, L. R. Taft, I. H. Butterfield, W. J. Terney, George Kelly.
Reception—John T. Rich, W. W. Collier, Stephen Baldwin, D. D. Aitken, Geo B. Horton.
Program—The Business Committee, President and Marshal.
Cattle—C. A. Tyler.
Horses, Except for Speed—J. F. Brand.
Speed—Walter J. Snyder.
Sheep—W. E. Boyden.
Swine—George Kelly.
Official Veterinarian—Dr. D. S. Dunphy, of Parke, Davis & Co.
Poultry—George G. Winans; Assistant, Daniel Thomas.
Farm and Garden Products—W. J. Terney.
Dairy, Bees and Honey—Lawrence W. Snell.
Farm Implements and Machinery—Jason Woodman.
Vehicles—J. E. Rice.
Main Building and Miscellaneous:
Art—A. H. Griffith, Detroit.
Needle Work—Wm. Dawson.
Horticulture—Prof. L. R. Taft.
Educational—George B. Horton; Assistant, Thomas M. Sattler.
Mining Exhibit—W. J. Galbraith.
Gates—F. B. Ransford.
Marshal—Byron E. Hall.
Concessions—The Business Committee.

IMPROVEMENTS.

During the summer of 1906 the following new buildings were erected on the grounds:

Nine stock barns, each 28 x 240 feet, well lighted and connected by covered walks. The aisles of the cattle barns are paved with asphalt brick and the floors of the swine barns are of cement.

Two new speed barns, each 24 x 180 feet, with projecting roof, eight feet on each side. These barns are ceiled and floored with wood, and are complete and modern in every respect.

A poultry building, 40 x 150 feet, of wood, well lighted and with permanent coops.

An agricultural building, 40 x 150 feet, floored with cement.

A dairy building, 40 x 150 feet, floored with cement, with a glass refrigerator, 8 x 60 feet.

Bleachers north of the grand stand to seat 2,000 people, with room under for a dining room and with kitchen attached.

Eight toilet rooms were constructed, the old ones being rebuilt, and all supplied with modern fixtures.

Six toilet rooms, four of them being in two brick buildings conveniently located, and two being under the grand stand, were erected under contract by Watson Bros., of Port Huron. These are finished with the best modern fixtures, and under the contract Watson Bros. may charge for admission for their use. The Society has the right of purchase at a stated price at any time within five years and at the end of that time must purchase them.

Other new buildings are:

A horticultural building of brick and tile, 70 x 160 feet, well lighted and with cement floor. Also another building of the same size and construction, now used for the offices, and for the needlework and educational exhibits.

A band stand of fine design and costing $2,500.00 was erected in the grove.

An iron fence 700 feet in length was erected in front of the grand stand. Electric fixtures were put in to the value of $11,482.04, which provided for lighting the grounds and buildings very completely.

Additional sewerage was provided and facilities for drinking water; 25 sanitary drinking fountains were provided. A large sum was expended for walks and drives, using cinders and gravel and crushed stone for that purpose. A picket fence was built along the frontage of the electric railway terminal.

On the grounds shrubbery and trees were planted, a large acreage of lawn seeded, and the border around the Michigan building ornamented.

Considerable work was done on the track, and it is very much improved.

THE FAIR OF 1906.

Was held August 30th to September 7th. It was open on Sunday, but on that day there were no races and no shows open.

The entries in all departments were large, much larger than at any previous fair, and much temporary room had to be provided for stock.

The receipts were also much greater, as will be seen by the report of the treasurer.

MEETING OF THE EXECUTIVE COMMITTEE.

The Executive Committee met at the office of the President on the Fair Grounds, Tuesday, September 4th, at 9:00 A. M.

There were present the President, Secretary, Treasurer and Messrs. Brand, Stevenson, Snell, Tyler, Winans, Doherty, Terney, Ransford, Aitken, Hall and Fifield.

On motion, O. E. Bartlett, of Detroit, T. D. Seeley, of Oakland, and W. F. Johnston, of Roscommon, were appointed Judges of Election.

The caucus of the society was called to meet at the Michigan Building on Wednesday, September 5th, at 11:00 A. M. The place of election was fixed at the office of the Secretary.

On motion, the President was requested to appoint a committee of three, who with the President and Secretary, shall be instructed to report on a revision of the constitution of the Society at the Winter meeting.

The President appointed as such committee, Messrs. Aitken, Fifield and Rich.

CAUCUS.

A meeting of the Society was held at the Michigan Building on Wednesday, September 5th, at 11:00 A. M.

Called to order by the President. Mr. A. J. Doherty was called to the chair. The President reported the resignation of Mr. H. E. Powell. The resignation was accepted.

On motion of Mr. Aitken a committee of three was appointed to present names of persons as candidates for officers of the society. The Chairman appointed as such committee, A. T. Donaldson, of Macomb, John Stoffer, of St. Clair, and Dr. J. B. Bradley of Eaton. A recess was taken for twenty minutes. Reconvened after recess.

The committee reported on nominations as follows:

President—Fred Postal, Detroit.

Vice-President—L. Whitney Watkins, Manchester.

Secretary—I. H. Butterfield, Detroit.

Treasurer—John McKay, Romeo.

Members of the Executive Committee for two years (terms expire January, 1909)—J. F. Brand, Saginaw, Saginaw County; Archibald J. Peek, Jackson, Jackson County; A. E. Stevenson, Port Huron, St. Clair County; C. A. Tyler, Nottawa, St. Joseph County; Nicholas J. Whelan, Holland, Ottawa County; Wm. Dawson, Sandusky, Sanilac County; Vincent V. Green, Detroit, Wayne County; Lawrence W. Snell, Highland Park, Wayne County; George Kelly, North Branch, Lapeer County; Daniel Thomas, Pontiac, Oakland County.

Member of Executive Committee to fill vacancy—L. C. Holden, of Sault Ste. Marie.

The report was accepted and adopted. Adjourned.

ELECTION.

The Annual Election was held at the office of the Secretary on the Fair Grounds on Thursday, September 6th, from 9:00 A. M., to 5:00 P. M.

The judges before appointed having duly qualified, Hon. T. D. Seeley was elected chairman.

At the closing of the polls the ballots were counted by the judges and the President of the Society and the result declared as follows:

Whole number of votes cast	196
For President, Fred Postal	196
For Vice-President, L. Whitney Watkins	195
For Secretary, I. H. Butterfield	196
For Treasurer, John McKay	196
For Members of the Executive Committee for two years:	
Albert E. Stevenson	195
Wm. Dawson	195
George Kelly	196
Archibald J. Peek	196
Daniel Thomas	196
C. A. Tyler	196
Lawrence W. Snell	193
J. F. Brand	194
V. V. Green	196
Nicholas J. Whelan	196
To fill vacancy, L. C. Holden	196

WINTER MEETING OF THE EXECUTIVE COMMITTEE, JANUARY, 1907.

The Executive Committee met at the Downey House, Lansing, Monday, January 14th, at 8 o'clock P. M., as per call of the President.

Present, Messrs. Postal, Butterfield, McKay, Brand, Stevenson, Tyler, Boyden, Dawson, Rice, Snell, Kelly, Winans, Doherty, Galbraith, Terney, Holden, Ransford, Taft, Aitken, Hall, Fifield.

On motion a recess was taken to 9 o'clock A. M., January 15th.

Met at Downey House, Lansing, Tuesday, January 15th, 1907, at 9 o'clock A. M. Roll called.

Present, the President, secretary, treasurer, Messrs. Brand, Stevenson, Tyler, Boyden, Dawson, Rice, Snell, Kelly, Doherty, Galbraith, Terney, Ransford, Taft, Aitken, Hall, Fifield, Holden. Quorum present.

Minutes of last meeting read and approved.

President Postal read his annual address as follows:

Gentlemen of the Executive Committee, Michigan State Agricultural Society:

It is with pleasure that I report for 1906 the most successful fair in the history of the Michigan State Agricultural Society, and indeed in the history of the State. The exhibits in all departments far surpassed those of any previous fair, while the attendance and total receipts as shown by the returns were much greater than ever before. Our fair is now comparable with other great State Fairs, in most respects; being surpassed by none of them in general character of the exhibits made.

The total receipts of the year exclusive of money borrowed as reported by the treasurer has been \$123,032.28, which is \$33,401.90 more than in 1905. The receipts from gate admissions indicate an attendance about 25% greater than in 1905, which is a gratifying increase, as showing the increased popularity of the fair with the people. The railroad coupon tickets show nearly twice the number of people coming from the interior

of the State than at previous fairs, not mentioning the very large increase coming over the suburban lines.

The exhibits and entries as shown by the secretary were:

Total entries	8,955
Total amount of premiums offered, exclusive of speed and cups and medals	$29,393.25
Total amount premiums awarded—cash	21,720.35
Value cups and medals	2,500.00
A grand total of premiums	24,220.35

These totals are, I am informed, about 25% greater than ever before.

IMPROVEMENTS.

While we have much larger facilities for holding a fair than ever before we are handicapped by lack of buildings for the proper display of our exhibits. The Society has, however, though laboring under disadvantages as to time, provided buildings and accommodations which, though inadequate, will house large exhibits. It was thought the stock barns erected this year would accommodate all the entries that could be expected, but we found at the beginning of the fair that fully one-third of the cattle, sheep, and swine were lacking shelter, and tents with temporary quarters were provided for them. This temporary shelter is very expensive, because all that is done in that line is of no value after the fair. The requests of the superintendents of these departments for greater space are warranted, and if possible should be provided before another fair. The live stock exhibit is a great feature of any fair, and the continuation of large exhibits is dependent on the convenience and accommodation given to exhibitors, and while the exhibitors this year were discommoded by use of temporary quarters, they realized the situation, and I think left with the feeling that they would all come again.

The Poultry Department, the Farm and Garden Department, and the Dairy Department also found the space, though larger than heretofore, entirely too limited for their respective departments. The requests of the superintendents of these departments for more space is entirely justifiable and should be met if possible. The horticultural department seems to be more nearly accommodated than any other department and the building is entirely satisfactory to the superintendent and the exhibitors. As shown by the report of the superintendent it was the finest and largest exhibit in that department ever seen in the State.

The Art, Needlework and Educational Departments, though fairly well housed, can never be made what they should be until more and better space is provided. The Needlework Department especially needs dust-proof cases in which to show work, or exhibitors of the best handicraft will not exhibit their goods. With the permanent location of the fair the improvements made remain for continued use and there is no question but that with the increased receipts which can be expected the Society may annually add to its equipment, but owing to the large amount needed it will still take several years to complete the equipment of the grounds from the receipts so as to make them convenient for holding a large exposition.

The arrangements for water and toilet conveniences are now fairly adequate and satisfactory to visitors. With an increased attendance hoped for and expected there will be more toilet conveniences needed.

Lease and contract was made by the Business Committee with Watson Bros. for the construction and maintenance of six toilet rooms for a term

of years, with the privilege of charging a five cent admission, and of purchasing at the option of the Society after October 1st, 1907, at prices stated, and agreement to purchase at the end of five years.

During the height of the exhibition the water pressure at the grounds was quite low. In order to overcome this it has been suggested that a well be put down from which water could be pumped with a gasoline engine that would augment the supply furnished from the city water mains. I understand that a driven well of moderate capacity will in that section furnish an unfailing and abundant supply of water.

The premium list was greatly increased in amount and the classification enlarged in 1906. Exhibitors showed their appreciation in the large exhibit made. The improvement in the premium list should be continued until it becomes equal to the best among the State Fairs.

It has been suggested that exhibitors of carriages and vehicles might be willing to combine and erect a building for the exhibition of their goods under a contract for the use of certain space therein for a term of years. I am told that the annual expense to these exhibitors in providing temporary quarters is very large interest on the sum that would be required for a proportionate cost of erecting the building, and the latter would be far more satisfactory for the display of goods. If there is such a feeling among these exhibitors I suggest that the Business Committee take the matter up with them and ascertain what can be done in that line.

Shelter is also needed for exhibition of agricultural implements, and should be provided at as early a date as possible.

TRACK.

The mile track on the grounds, having been graded just previous to the fair of 1905, was left in a very crude condition. Considerable labor was expended on it during the spring of 1906, and while not perfect, horses in some of the classes were able to make very fast time. However, it is not yet in condition for the best work, and will need attention at the earliest moment in the spring. I think it advisable to keep the track in good order and encourage the use of the track and stalls by horsemen. Horsemen are favorably disposed towards the location, and I think will use the track for training to a large extent provided that it is in good order. The rent of stalls in that would pay for the care of the track and bring it to fair time in perfect condition without expense, and at the same time make it popular with the horsemen and in that way bring more entries to the races.

TRANSPORTATION.

In consequence of the very large exhibit made in live stock and farm implement departments the railroad facilities at the grounds became entirely inadequate. The Grand Trunk Railway did the best it could with the conveniences at hand, but the track room is far from sufficient for handling the exhibits of a large fair. Conference has already been had with the superintendent of the G. T. R. R. relative to an increase of siding on the grounds, the suggestion being made that an additional track be put in at the south end for unloading heavy implements, and that a siding be put in at the north end of the grounds sufficient to accommodate all live stock. This will separate live stock from other cars, and bring the siding much nearer to the stock barns and provide plenty of room for unloading and reloading. The superintendent approved the necessity for these improvements,

and plans and drawings have been made by the engineer. With these improvements, I think the exhibits would be unloaded promptly and reloaded at the close of the fair so as to make it satisfactory to exhibitors and the Society. The Business Committee should be authorized to continue the work of making this arrangement with the Grand Trunk Ry.

A large number of exhibits in packages and less than car lots are shipped, billed to the fair grounds, which, owing to non-prepayment of freight and lack of instructions are delayed at the freight stations. I think if the Society should provide a competent man for a few days before the fair, who could aid in forwarding these shipments to the grounds, it would be so greatly appreciated that it would be worth the small expense it would cost.

The transportation for passengers was reasonably good. Those arriving on the D. & M. division of the Grand Trunk are of course well cared for. People who arrive in the city on other roads and by suburban lines are carried by the D. U. R. with reasonable promptness and convenience. No accidents occurred on the electric line, and although at times the cars were crowded, they handled the crowd very nicely.

CONCESSIONS.

The returns from sale of concessions on the grounds were very much larger than at any previous fair, the total receipts from this source alone being $28,105.76.

Proper facilities for dining rooms and lunch stands at the fair are a very important consideration to visitors. In the absence of a permanent dining room and rooms or pavilions for lunch stands erected with proper conveniences for shelter and cleanliness it is difficult to secure temporary quarters for these purposes that are entirely satisfactory. While there were sufficient eating facilities on the grounds this year some of the stands were owned by parties who did not keep them up to the proper standard of quality or cleanliness. This is a matter that can be improved and will no doubt receive proper attention from the committee in charge. There are some concessions asked for from which good revenue can be obtained, but which are of themselves of doubtful character, or obtained under the guise of innocent amusements suddenly change to decidedly immoral things. In my opinion the Society should not sell privileges for any gambling schemes no matter how much may be offered for them, and contracts should be drawn so as to prevent any abuse of their terms in this direction.

The Midway feature of the fair seems to be in demand by the people who visit the fair, and can be made a source of revenue and at the same time be conducted in a manner unobjectionable to the people by securing high-class entertainments and having them conducted in an orderly manner.

GATES AND ADMISSIONS.

The revenue of the society is so largely dependent upon the administration of the Gates and Ticket Department that it needs the most careful attention. Outside of the Press, who render the Society much unpaid service, there is no reason for an extended distribution of complimentary tickets, and I advise limiting the number as far as possible.

The matter of free admissions for exhibitors and their helpers and for those who hold concessions on the grounds is quite difficult to deal with, not so much in the matter of giving these admissions to the proper people, but in preventing their abuse. The increased growth in attendance at the fair

makes this matter much more difficult than formerly. I learn that at some fairs the practice of dealing with people who have privileges is to grant one admission for a certain amount paid for privilege, and if more are required to sell at a reduced rate for that purpose only, and that this system works well. While I have no scheme at present to present I suggest that the Business Committee take this matter up at an early date with a view of devising some plan which shall reduce to a minimum the leakage in this direction.

The handling of the gates is so closely allied with the ticket arrangements that it would seem advisable to place the care of the gates and admissions to the grand stand in the hands of the Finance Committee, which would place the control of admissions in the hands of one department, and this committee would then be responsible for both the admissions and the care of the tickets.

FIRE PROTECTION.

The fire department of the city of Detroit sent out a crew with engine which was on the grounds during the fair. The temporary quarters furnished are unsatisfactory to the department, and better provision will have to be made to secure the placing of a crew at the next fair.

POLICE.

The police department in the city of Detroit very generously supplied officers in uniform for policing the grounds and good order was maintained through their services. The thanks of the Society are due the police department and the officers in charge. Under the by-laws this year the chief marshal had charge of the police. I am inclined to think that the duties in connection with the marshal are sufficient for one man, and that the police supervision should be in the hands of a superintendent of police. I recommend the change.

While the President is now ex-officio member of all committees under the by-laws it is my feeling that he should be named in the by-laws as being associated with the Business Committee with the authority of a vote in the conduct of the business of the Society and the arrangements for holding the fair.

As you will see from the report of the Business Committee in preparing for the fair of 1906 obligations were incurred far in excess of the ability to pay from the receipts of the fair. I am not questioning the propriety or advisability of making these obligations. It seemed necessary to take chances in these lines, and while the receipts of the fair were large there was reasonable expectation that they would be still larger; on the other hand some of the improvements started cost more than was expected. The obligations have been settled by payment of money and by notes, the amount of the outstanding notes at this date being $79,337.80, besides those secured by bonds, so arranged that they can be carried over until next fair. These obligations are, of course, practically a mortgage on the surplus receipts of the next fair and amount to as much or even more than can be expected. In consequence not many improvements can be made in the way of buildings during the coming season as we must now *catch up* before we can *go ahead* in this direction.

In settling up the affairs of the Society after the fair the President and Business Committee promised some of the parties who accepted notes for

balance due them with the promise that they could be renewed and carried over until after the next fair that the Society would issue second mortgage bonds to the amount of $———, which bonds should be used as collateral for the payment of notes. I trust the Executive Committee will approve this action of the President and Business Committee, as it seemed necessary to make this promise.

I feel that the future of the Society is bright and promising, but it will take a little time to develop all that is desired and necessary if paid for from the receipts of the fairs. As you are aware, through a technicality the amount appropriated by the last legislature was denied us by the court. The Society expended the amount appropriated in the line provided by the act making the appropriation and paid the premiums out of its own funds. I think we can reasonably ask the legislature to reimburse the Society for this amount, and I recommend that a bill be prepared and presented to the legislature for this purpose.

Holding the fair for nine days has many advantages with some corresponding disadvantages. Being one of the early fairs makes it less difficult for the live stock exhibitors to be on hand and get in place at an earlier date than would be possible if they came from other fairs. The exhibitors get settled and in places, and the superintendents are enabled to arrange their exhibits so that before the crowd of visitors begin to appear everything is in order. This is especially desirable in view of the fact that Labor Day occurs during the dates of the fair and is the *one* day when more city people can attend the fair than any other. The last fair was opened on Sunday in deference to the wishes of many classes of people who could not attend on other days. I think, however, in view of the fact that Saturday is a half holiday and Monday a full holiday, and also in view of the fact that the fair cannot be opened in such a manner as to demand full price for admissions, while the expenses continue at about the same rate as on other days, it is my opinion that we would receive as much total net revenue if we closed the gates on Sunday, and at the same time give our exhibitors and superintendents a little *let up* on the strenuous work necessary during the fair. It will also be in deference to the opinion of a large number of people that the fair should not be opened on that day.

I thank you, gentlemen of the committee, one and all, for your co-operation and labor in making possible the results of the year; and I ask of you the same spirit and work for the coming year, which I trust may be one of prosperity for all our people and of success to this Society.

The Secretary presented a statement of Entries and Premium Awards, Fair of 1906.

Department	Entries.	Paid.	
Cattle	1,137	$8,166 00	
Horses	306	1,922 00	
Sheep	1,198	3,298 00	
Swine	709	2,301 00	
Cost of cups and medals awarded		2,500 00	
			$18,187 00
Poultry	1,543	$1,388 75	
Grains and Vegetables	1,004	1,116 50	
Dairy and Domestic Products	274	501 89	
Miscellaneous	24	124 86	
Art	457	511 60	
Needle and Fancy Work	787	356 75	
Fruits and Flowers	1,492	1,610 50	
Educational	44	523 00	
			6,133 85
Total money and cup awards			$24,320 85
Total amount offered:			
Cash		$29,393 25	
Cups and medals		4,000 00	
Grand total			$33,393 25

FINANCIAL STATEMENT.

Four hundred and fifty-eight business vouchers were issued during the year amounting to $87,731.30.

The following is a summary of the expenditures as charged to the several accounts:

CLASSIFICATION OF BUSINESS VOUCHERS, 1906.

(Chargeable to the expenses of the year.)

Executive Committee, salary and expenses	$188 86
Business Committee, salary and expenses	638 40
Finance Committee, salary and expenses	1,070 32
Secretary's office, salary and expenses	2,385 56
Treasurer's office, salary and expenses	1,227 79
Postage, printing and stationery	3,000 80
Advertising	6,737 46
General expense	5,441 29
Telegraph, Telephone, freight and express	370 82
Diplomas, cups, badges	2,709 44
Attractions	14,725 00
Sundry expenses	878 62
Care grounds and buildings	1,650 11
Interest	5,425 82
Tools and Implements	246 52
Cattle department	237 40
Horse department	179 68
Speed department	9,927 24
Sheep department	165 15
Swine department	127 35
Poultry department	286 70
Agricultural department	177 77

Dairy department	$427 55
Farm Implement department	82 10
Vehicle department	86 10
Needlework department	276 84
Art department	225 68
Horticultural department	252 29
Educational department	122 46
Mineral department	390 12
Marshal's department	1,134 80
Gates department	812 15
Concessions department	1,402 85
Premiums	21,720 35
Total	$84,731 30

IMPROVEMENTS AND ADDITIONS TO PROPERTY.

EXPENDITURES FOR IMPROVEMENTS OF GROUNDS AND BUILDINGS.

Buildings	$$99,352 89
Grading and surfacing walks and drives	7,896 42
Sewer, water, and toilet rooms	14,254 87
Track improvement	1,323 82
Planting and improving grounds	2,186 31
Fence in front of grand stand	1,100 00
Turnstiles	1,128 00
Electric light improvements	9,719 97
Track tools	463 25
Material on hand	346 00

The balance of expenditures over receipts of $89,370.45 was carried over in notes and accounts unpaid.

INVENTORY OF PROPERTY, 1905.

Cost of land	$81,000 00	
Drainage and Sewer	3,650 88	
Water	3,400 38	
Track	7,777 96	
Fences	1,158 72	
Grading, Walks and roads	2,460 03	
Electric Light	6,449 94	
Michigan Building	18,058 70	
Grand stand and seating	55,229 56	
Horse barn	31,511 08	
Speed and other buildings	11,949 35	
Main building	31,144 39	
		$253,790 99

COST OF ADDITIONS TO BUILDINGS AND GROUNDS, 1906.

5 cattle barns, each 28 x 240 feet
2 sheep barns, each 28 x 240 feet
2 swine barns, each 28 x 240 feet
2 speed barns, each 24 x 180 feet
1 poultry house, 40 x 150 feet
1 agricultural building, 40 x 150 feet
1 dairy building, 40 x 150 feet, with ref.
1 brick horticultural building, 70 x 160 feet

1 brick exhibition building, 70 x 160 feet		
1 bleacher, with dining room, 60 x 160 feet		
1 dining room, 40 x 100 feet		
8 closets, each 15 x 40 feet		
1 band stand, 32 x 56 feet		$87,994 83
12 exit turnstiles	$1,128 00	
Addition to electric wiring and lamps	11,483 98	
Addition to water, sewer and closet system	14,254 87	
Grading and Improving grounds, walks and drives	8,275 87	
Iron track fence	1,100 00	
Permanent work on track, 1906	1,280 47	
Tools and implements on hand	1,465 84	
Other materials on hand	1,023 50	
Furniture and fixtures	1,957 15	
		41,969 68
Grand total		$383,754 50

REPORT OF THE TREASURER.

Receipts to January 2, 1907.

Balance on hand Jan. 6, 1906		$1,601 92
A. E. Stevenson		14,742 84
P. B. Robinson		58,899 25
Sundries		877 63
I. H. Butterfield, secretary		42,491 49
Fred Postal		9,407 20
R. R. receipts, less Butterfield's report	$12,958 50	
	4,283 00	
		8,675 50
Loans, Dime Savings Bank		9,909 18
Loans, People's Savings Bank		33,959 85
Voucher No. 395, A. J. Smith		7,000 00
Advance sale tickets, 1907		14,415 63
Overdraft		1,255 47
		$203,235 96

CONTRA.

Total Deposited in Dime Savings Bank	24,070 34
Total deposited in People's Savings Bank	179,165 62
	$203,235 96

RECEIPTS FOR SALE OF TICKETS.

Advance sale, as per Postal's statement	$10,589 30
General admission ticket sales	46,472 50
Grand stand and admissions, reserve and boxes, Robinson	12,426 75
Railroads	12,958 50
Total admissions and grand stand	$82,447 05

APPARENT TOTAL RECEIPTS, FAIR 1906.

P. B. Robinson, sale of tickets		$58,899 25
A. E. Stevenson, paid treasurer during fair		14,742 84
Butterfield, paid treasurer	$42,491 49	
Less paid for concessions, 1907	11,184 00	
		31,307 49
Fred Postal, advance sale tickets, 1906		9,407 20
Railroad tickets	$12,958 50	
Less received by Butterfield	4,283 00	
		8,675 50
		$123,032 28

PROCEEDS OF MONEY BORROWED CREDITED ON BANK BOOKS.

Dime Savings Bank		$9,909 18
People's Savings Bank		33,959 85
		$43,869 03

DISBURSEMENTS.

To January 2, 1907.

Cash on hand Jan. 16, 1906		$1,601 92
Total deposits, Dime Savings Bank		22,488 80
Total deposits, People's Savings Bank	$166,879 68	
Less	178 16	
		166,692 52
Voucher No. 202, $135.75, paid as $135.00		75
Voucher No. 389, not paid through bank		3,000 00
Voucher No. 404, not paid through bank		8,196 50
Overdraft if all checks are presented of		1,255 47
		$203,235 96

CONTRA.

Total checks issued on Dime McKay's Register	24,070 34
Total checks issued on People's McKay's register	179,165 62
	$203,235 96

RECONCILEMENT OF PEOPLE'S BANK ACCOUNT.

Total checks issued, McKay's register	$179,165 62
Nov. 2nd, G. T., charged back	112 16
Oct. 1st, Anderson Carriage Co., check charged back	75 00
	$179,352 78

CONTRA.

Total vouchers returned by People's Bank	$166,484 35
Voucher No. 202	75
Voucher No. 359	3,000 00
Voucher No. 404	8,196 50
Outstanding checks	1,671 18
	$179,352 78

Balance Dime Savings Bank, Jan. 2, 1907	20 38
Balance, People's Savings Bank, Jan. 2nd, 1907	395 33
Overdraft at People's if all checks were presented	1,255 47
	$1,671 18

The reports of the Secretary and Treasurer were referred to the Finance Committee.

REPORT OF THE GENERAL SUPERINTENDENT AND CHAIRMAN OF THE BUSINESS COMMITTEE.

To the President and Members of the Executive Committee, Michigan State Agricultural Society:

Gentlemen—As General Superintendent I beg leave to submit the following as my annual report, and as your secretary has informed me he has prepared a full and detailed report of all financial transactions, I will only treat of matters in a general way, without duplicating cash and figures of secretary.

Possibly one of the first great improvements at the fair grounds that attracted your attention in 1906 over 1905 would be the general appearance of the grounds in the walks, drives, trees, shrubbery, etc. I think it will generally be conceded that as you enter the grounds the first impression is very pleasing, for which our thanks are largely due to Prof. L. R. Taft, as the business committee placed this part of the work under his charge, and he certainly made a wonderful change for the better when the amount expended and the short time is taken into consideration.

WALKS AND DRIVES.

Some thought we should have had a large number of cement walks, but when we learned how much it would cost to put in the number of walks necessary, we decided to get along for the present with something of a cheaper nature; and in fact we practically put down the foundations, as it were, for the walks, so that some time in the future, when our financial condition will permit, we will go ahead and complete them in a more substantial way.

In the fall of 1905, at the close of the Fair, as you will remember, we had no roads of any kind, and we immediately set to work to grade up roads, where actually needed, and did it in such a manner as to drain the grounds and take the water off as well as making the roads. On account of the sandy nature of the soil we had to put some covering on them. In front we used gravel, which was comparatively cheap, and for the rest we used cinders, as we could find nothing that would answer as well at so little cost.

BUILDINGS.

In starting out the year, we were confronted with the fact of having no buildings, except horse barn, Michigan building and what is called the Main building, and the Fair having permanent quarters and being located at Detroit, we realized that the people would no longer be satisfied with a large county fair, and would insist on the Michigan State Fair taking advanced steps and placing itself at once in the front ranks with other State Fairs, and while our buildings for cattle, sheep and swine were cheaply built, they are very satisfactory and will last and be a credit to the Association for a great many years. Although overcrowded this (1906), I believe they will prove adequate and sufficient, and it will not be necessary to increase them; but I should like to see as soon as possible a building in connection with stock buildings, to be used for judging purposes, and the same is really necessary, but believe that our exhibitors will be patient and wait for this.

The Dairy, Poultry and Agricultural buildings are not large enough, and in fact are not good enough for permanent buildings, and it was very difficult for the superintendents of these departments to take care of exhibitors. In fact, they could not do justice to their great exhibits, and we would willingly have provided larger and better accommodations had we been in financial condition to do so; and we should keep these departments particularly in mind when future improvements are being considered.

The Horticultural Building is of a more permanent character and cost more money than the other buildings, but it was felt to be out of the question to put up a building in this location without keeping it in harmony with the Main Building, so called, and show some general improvement in the way of permanent buildings, and I believe we made no mistake in this.

When we look back and see what a great show Prof. L. R. Taft produced in fruits and flowers, and realize without doubt it was the best of anything of the kind at any State Fair held, our Association and the State at large should feel very proud of it.

There may be some question as to whether or not we should have put up such good speed barns, but as they were built largely at the desire of the president, believing they would be the means of bringing us in a nice revenue from such farm owners of speed horses, at the time it looked to be a good investment. We were assured we would have the barns filled practically the year round at a rental of $1.50 per month for each stall, and to prepare for this, we not only had to build the new stables, but had to put in floors and seal up and line those built in 1905, as they were not built with the idea of being used in winter. For some reason, I presume due to the condition of the track and general conditions with horsemen, the anticipated revenue was not forthcoming.

The bleachers at the north end of grand stand was built at the request of Mr. Doherty, chairman of the Financial Committee, believing that this would pay, not only in increased revenue, but in giving better accommodations to our exhibitors. The grand stand was also enlarged as we knew it was crowded and running over in 1905, and we counted the additional income more than justified the expenditure to say nothing of the great convenience and comfort of visitors.

TOILETS.

The greatest criticism of 1905 was our poor accommodation in the way of toilets, and knowing that these criticisms were just, we realized that the matter had to be taken in hand and placed beyond a possible chance for criticism this year (1906). I think it is generally conceded that we handled this matter entirely satisfactory to exhibitors and everyone visiting our grounds.

Although we had a sewer running through the grounds, we had a somewhat difficult proposition to solve, as the grounds are nearly level, with very little fall, and sewers have no outlet, as it empties into a county ditch near a farm. However, we tried a system of cess pools, that was perhaps somewhat expensive compared to a condition of a sewer running into running water, which fortunately proved all that could be desired, and worked out most satisfactory. In locating the toilet buildings, we met with some difficulties, as some locations we desired could not be used for the reason that we could get no fall to the sewer.

COMFORT STATIONS.

Knowing that we could not provide the proper and necessary conveniences for the public on account of not having sufficient means to do so, we accepted a proposition from Mr. Robert Watson to establish a number of pay stations according to plans prepared by Mr. Louis Kamper, architect. These were filled with a system of fans, which worked to perfection. In this way we were enabled to provide accommodations to our visitors, and the buildings were built so neat and tastily that they added to the general appearance of the ground; and another year, covered with vines and surrounded with shrubbery, will prove a great help to us.

It is generally conceded that what at one time looked to be a source of considerable annoyance to us has been solved in such a manner as to meet with the approval of the Board, our exhibitors and visitors.

WATER.

The question of water, principally drinking water, is always a source of anxiety and annoyance, when drinking tanks, water barrels, etc. are used; even by being careful with help, water gets stagnant, ice runs out and water gets warm, resulting with a number of sick people on the grounds, so we established what is known as sanitary drinking fountains, which gave the best of satisfaction and worked to perfection, although the cost was more than for tanks, barrels, etc. There is no cost or expense to follow and they will last for years.

The supply of water from the city water works as at present regulated is not sufficient, and our machinery people met with considerable inconvenience. Something will have to be done before another year to remedy this. Our machinery and implement men made a great show and added much to our success, and are entitled to every possible consideration on the part of the management.

When we had finished all the building improvements we felt we could possibly undertake we were confronted with the fact that two of the departments that added as much as any departments we had in connection with the fair, viz., the Educational and ladies' department, needle work, etc., had no roof to cover them, also, no place for bank, telegraph offices, and offices for the administration of our own affairs, so we decided that although late, after consulting with our builder and the man supplying our material, and they expressing a willingness to stand by us and carry us through, to go ahead with a building similar to the Horticultural Building, keeping in mind the future of the fair and its needs in years to come. We by no means thought this building was an ideal building for the purposes, but believed it would answer for present, and could be used for Dairy Building, Agricultural Building or something of this kind when the time came that we could have an administration and buildings for educational department and needle work.

FIRE HALL.

The City Fire Department and our president were quite insistent in the building a fire hall, and at one time threatened not to give us fire protection unless a hall was built for their use. When we looked over plan and size of building they required, and learned the cost, we felt that we could not

possibly undertake this building, in view of indebtedness we had already incurred, and we did not see anything we could leave out and in any manner satisfy our exhibitors. Finally they decided that for this year (1906) they would occupy a tent and serve notice on us unless we had a building for next year, they would give us no protection.

This is a subject, in my opinion, for the Board to take up specially and give explicit directions.

TURNSTILES.

In 1905 it was said that thousands, on account of poor arrangements at street car entrances, walked into the grounds without paying any admission, and one of the important questions decided upon was a plan to avoid this occurring this year (1906). Our arrangements were properly planned, and the exit turnstiles all that could be desired, but the contractor with the entrance registering turnstiles did not fill his agreement, as turnstiles, so far as registering is concerned, were a failure. But while they failed in this way they were properly protected, as everyone presented an admission ticket to gain admittance to the grounds. Of course it is needless to say we refused to accept and pay for these turnstiles.

OUR CONCESSIONS, ETC.

The exact figures for privileges, concessions, etc., will be covered fully in the secretary's report, and you no doubt will be pleased to know that we collected more by quite a considerable sum than any other fair in the United States.

In discussing this subject at the annual meeting of managers of fairs at the association all seemed surprised at our success in this line. Hamline, Springfield and Iowa are the three that are considered the largest, and secure the most money along this line, and we are congratulated by these managers on our solution of this question the past year. No other fair in the country secured so much money as we did from our shows. Some fairs have had so much trouble with the show business in managing it themselves that they cut it out entirely and are talking of cutting it out next year on account of trouble and annoyance with such a small source of revenue as they obtained.

The reports show (all fairs considered) that our profits were greater in 1906 than any other fair in the country, and some had a much larger attendance.

CONCLUSION.

There are many other matters I might refer to, but as our president and secretary have undoubtedly covered them, I will only say in conclusion that, everything considered, our new grounds, condition of finances, no state or outside help, we must feel proud of our success, and while it was necessary to create considerable of a floating indebtedness, which is small when we consider our improvements, the value of our property and the great success secured, we must confess it has been the means of taking us out of the class of large county fairs, as heretofore, and placing us in the front ranks with the big State Fairs of the country.

While there is much ahead to be done and from time to time a large a mount

of money will have to be expended. I believe that for this year we should go slow and incur no indebtedness of any kind that could as well be avoided, and no new buildings or improvements should be undertaken until we at least clean up our present floating indebtedness.

I wish to thank the superintendents of the different departments for their honest and conscientious efforts to make their departments the great success they were, and through their gentlemanly conduct we have been receiving nothing but letters of congratulation and most satisfactory and pleasing reports from exhibitors, which have already secured the success of the fair of 1907.

At this time I wish to express individually my personal thanks and appreciation to these superintendents who did so much to the honor and credit of Michigan's greatest State Fair.

A. E. STEVENSON,
Chairman.

REPORTS OF EXECUTIVE SUPERINTENDENTS.

CATTLE DEPARTMENT.

To the President and Executive Committee of the Michigan State Agricultural Society:

Gentlemen—Your superintendent of cattle begs leave to offer the following report. At the Michigan State Fair held in the city of Detroit, and closing Sept. 7th, 1906, the cattle exhibit was truly a record breaker both in quality and numbers of the exhibit.

Both the beef and dairy branches of the cattle industry were represented by animals of the highest type of their respective breeds.

In the beef classes, while the Short-horns led somewhat in numbers, as might have been inferred, the Aberdeen-Angus, the Galloway's and the Herefords were very much in evidence, showing conclusively that all of these valuable breeds of cattle must positively be reckoned with an inventory of the beef cattle interests of this great state of Michigan.

In the Short-horn classes sixteen herds were represented, nine of which were from our own state. To make special mention of any of these magnificent herds would, perhaps, be doing an injustice to the balance. The entries made by A. E. and A. G. Stevenson of our own state and George H. Oke, of Ontario, were a cattle exhibit alone that would do credit as an entire show at a modern fair. What is true of these herds might perhaps be said with equal force of others.

The Polled Durhams brought to the ring four herds, two of which were home state cattle. The quality of the exhibits in these classes were such as to show that this valuable breed should be encouraged.

The exhibit of Aberdeen Angus was indeed a most striking one, six herds being represented, four of which were from our own state.

Perhaps no handsomer cattle or none that attracted more general attention were shown than those found in the Galloway department. Here we found three herds from Michigan and one from outside the State.

A beautiful and also attractive lot of cattle were the Herefords, two herds of which were in from abroad and an equal number from home.

As we pass to the dual purpose animals we find first in numbers the Red Polled, and it is doubtful if any judge of live stock at the Michigan State Fair had a more difficult task on his hands (or met it more satisfactorily) than did Prof. Shaw, of the Michigan Agricultural College, when the two Michigan and four foreign herds of this breed were lined up before him in the show ring.

One magnificent herd of Brown Swiss from outside the state was proof positive of the fact that there was still another type of the dual purpose animal and that they were with us.

The showing made by the owners of dairy herds was the best your superintendent has ever seen at a state fair. While the number of animals shown was far in excess of that at most state fairs the quality did not suffer thereby.

In point of numerical strength the Holsteins led, being represented by seven herds, six of which were Michigan cattle.

Probably no finer show of Guernseys was ever gotten together at one state fair than that made by the four Michigan breeders, who had things all their own way in these classes.

While the handsome and useful little Jerseys were not strong in numbers, in quality the best this country has to offer was with us. The famous Marston farm of Bay City, Mich., and the Hood farm of Massachusetts, were the principal contestants, and it was indeed a battle royal. It is a matter of local pride that the Michigan herd won many first prizes, and at least one championship in the open classes.

I should feel that I was derelict in duty were I to fail to mention the "educational exhibit" of eighteen head of cattle made by the Agricultural College of Michigan. This exhibit was in no way a competitive one for the prizes offered by our association, but purely an educational one, and deserving of being highly commended. It was intended to (and did) present certain educational features and object lessons of a most practical kind. With each animal shown was a chart showing value and kind of feed given since the birth of the animal, thus giving the common farmer the opportunity to observe by comparison results that might be expected or hoped for with certain feeds and conditions—an experimental education that can and should be made invaluable to the every day breeder of the cattle of commerce on the Michigan farm. This is a feature that should be given every encouragement by the Society in the opinion of your superintendent.

On the morning of Sept. 6 our department made a display parade on the track in front of the grand stand of such merit that it is much to be regretted that there were not more spectators present. In this parade were forty-seven herds of pure bred cattle represented, thirty-three of which were bred and owned in the state of Michigan. One hundred and seven head of prize animals were shown in "fancy evolution" making a sight long to be remembered.

While we were glad indeed to welcome the eighteen splendid foreign herds of cattle shown at this year's fair, and sincerely hope that the number may be doubled at our next exhibition, it is still a matter of great local pride that while the foreign herds shown were of exceptional merit, and represented 34% of the entire cattle exhibition, 74% of the money in the open classes was awarded to Michigan cattle, all of which augurs well for the cattle industry in our state and the future of the exhibition at the State Fair.

C. A. TYLER,
Supt. Cattle.

HORSE DEPARTMENT.

The superintendent of the horse department made no report.

The show of the horses at the fair of 1906 was much larger than for several years. The increase in heavy draft horses was particularly noticeable, as well as the number of fine teams.

SHEEP DEPARTMENT.

To the President and Members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As acting superintendent of the sheep department during the Fair of 1906 I beg to submit the following report:

The showing made in this department at the last Fair was, in my opinion, the largest and best show of sheep, both as regards numbers and quality, ever made at any fair held within the confines of the State since the State Agricultural Society began making history and setting the pace in high class exhibits.

I think both exhibitors and visitors were unanimous in this opinion. It was an exhibit not only of which the Society may justly feel proud, but which furnished most conclusive proof that the breeding of that valued friend of man—the sheep—is being carried yearly to a still higher degree of excellence than ever before attained.

The total number of entries, including flocks and specials, was 1,205, and for single animals, 1,120. The actual number of sheep exhibited was approximately 950.

In my opinion the Society was exceptionally fortunate in securing the services, as judges, of men of such eminent ability and prominence as John P. Ray, of New York State, who judged the Merino breeds, and R. J. Stone, of Illinois, who judged the mutton breeds.

Universal satisfaction was expressed over the fairness and impartiality of the decisions of each in his department.

The accommodations provided were highly praised by the exhibitors, and greatly appreciated by those who were accommodated. Great forbearance was shown by those exhibitors who had to wait for the completion of temporary quarters before being able to unload their sheep.

If I may take the liberty I would most respectfully recommend that an enlargement of the capacity of the quarters for this department be made before another exhibit is assembled.

In my opinion it is imperative that the present quarters be enlarged by from 50 to 75% in order to provide ample accommodations for the exhibitors and the proper and economical handling of the department.

All of which is most respectfully submitted.

L. W. BARNES,
Acting Superintendent Sheep Department.

SWINE DEPARTMENT.

To Michigan Agricultural Society:

I submit the following report of the swine department for the year 1906:

Number of entries, 716.

Amount of premiums offered, $3,346.00.

Amount paid, $2,326.00.

The judging was done by Mr. Linson, of Ohio, and after getting through with his duties in that capacity he gave the exhibitors a very interesting talk on the breeding and fitting of swine for exhibition.

On the whole everything passed off very satisfactory.

Respectfully submitted,

GEO. KELLY,
Superintendent.

POULTRY DEPARTMENT.

Mr. F. Postal, Pres., Detroit, Mich.:

Dear Sir—At request of Supt. G. G. Winans of the Poultry Department, I herewith make you a brief report of exhibit, also suggestions.

Total number of entries were 1,543. Amount of premiums paid, $1, 386.25.

We have cooping capacity for about 800 birds, but we crowded in about 2,000—what is needed is some pens built. I would suggest the building be made larger, also a wing be put on for water fowl. Last fair we had two tents which was very unsatisfactory to breeders—and a good poultry exhibit is always attractive—and according to government reports that the product of poultry and eggs for 1905 exceed $300,000,000, all the gold mines in the world yield only a little more than half as much gold in a year. The poultry industry is being taken up not only in the country districts by farmers, but in every city in the Union—take Detroit, there are hundreds of mechanics who raise blooded poultry and show them at fairs and poultry shows—therefore we suggest we have a larger building, and a floor be laid in same, for you could always find the poultry house full of people when other departments were empty.

Wishing you the compliments of the season, I am,

Yours respectfully,

D. THOMAS,
Assist. Supt. Poultry Dept.

FARM AND GARDEN DEPARTMENT.

To the President and Executive Committee, Michigan State Agricultural Society:

Gentlemen—I respectfully report regarding the exhibit at the last State Fair in the Department of Farm and Garden Products, and County exhibits of Grains and Vegetables, that the exhibit of 1906 was undoubtedly the largest exhibit in this department that has ever been shown in Michigan. After filling the building provided for that department, 40 feet x 150 feet in size, nearly as much more space was occupied under the grand stand. This divided the exhibit and made its magnitude much less conspicuous, as well as being more difficult to arrange and oversee.

The early date of holding the fair also precludes the highest quality of vegetable and grain exhibit. Indeed it is almost impossible to secure a good exhibit of corn so early in the season.

The country exhibit was large, and that from the northern counties showed large gains in the production of grains and vegetables. The northern counties excel in the production of the latter in both quality and quantity.

I recommend some additions to the premium list as follows:

The present list offers five premiums for exhibits from counties north of

the south line of Gladwin and Mason counties. There were exhibits from eight counties this year and will probably be more next year. I recommend that two divisions be made of these counties: First, Ogemaw, Iosco, Alcona, Alpena, Presque Isle, Cheboygan, Emmet, Charlevoix, Antrim, Grand Traverse, Leelanau, Benzie, Manistee, Wexford, Mason, Lake, Osceola, Clare, Gladwin, Arenac; Second, Missaukee, Roscommon, Kalkaska, Crawford, Oscoda, Otsego, Montmorency and that four premiums be awarded in each division, and that two divisions be made of the remaining counties of the lower peninsula.

I suggest that the premiums for corn grown the year previous to the fair be continued, and that the premium list of 1907 contain offers for corn grown in 1906. Corn is one of the most important grain products of the State, and entirely inseparable from the successful raising of live stock, and I think the encouragement of improvement in that direction is very important. I would recommend some increase in the number and amount of premiums offered for corn.

I would further suggest that the business committee use their best efforts to provide a more suitable building for the Agricultural exhibit.

As it is at the present time I would be afraid to solicit exhibits for fear that we could not take care of them. I would prefer to have a much smaller exhibit and have everybody well satisfied. We have started on an upward movement in this line and should do everything possible to encourage exhibitors. Unlike live stock exhibitors, the exhibitors in this department derive very little benefit from any advertising they may secure and opportunity for sale of articles, hence the premiums they receive are the only compensation obtained.

W. J. TERNEY,
Supt.

Dairy Department.—No report.
Farm Implements Department.—No report.

VEHICLE DEPARTMENT.

Fred Postal, President Michigan State Agricultural Society, Detroit Michigan:

My Dear Sir—As Superintendent of the Carriage and Vehicle Department of the Michigan State Agricultural Society for the meeting in 1906 I beg leave to report:

There were fifteen of the leading carriage and vehicle manufacturers, and four motor car makers who had their goods on exhibition. It was certainly a good showing and a credit to the manufacturers and the Michigan State Fair Association. Everything was harmonious throughout the meeting, not one complaint being registered to me, and the best and friendliest feelings prevailed.

There are many matters to be presented at our winter meeting which I think will be of interest and of benefit to both the manufacturers and to the Fair Association regarding buildings for exhibition purposes, passes, etc., etc. Hoping to meet you all at the January meeting, and wishing you and your supporters the best possible success in your future work, I am, as ever,

Yours most respectfully,

J. E. RICE.

ART DEPARTMENT.

The art exhibit, superintended by Prof. A. H. Griffith, of the Detroit Museum of Art, comprised many fine pictures by noted professional artists, and pictures and statuary loaned, as well as a very large collection of the work of Amateur artists, made a very satisfactory show in the Michigan building.

It is greatly to be regretted that the space used for this exhibit is not at all adapted to an art gallery, as the arrangement for light is so imperfect as to make it difficult to arrange the paintings so as to show them properly. It is hoped that a properly constructed art gallery will soon be possible, and that this department of the Fair can be greatly enlarged and improved.

NEEDLE-WORK DEPARTMENT.

To I. H. Butterfield, Secretary Michigan Agricultural Society:

In accordance with rule six of said society, I submit the following as my report for my department for the year 1906:

The number of entries for the year 1906 in division 0 was 788. The number of entries for 1905 in all classes was 515, a very gratifying increase in exhibits.

I would recommend a further revision of the premium list, the revision made last year was quite satisfactory to the exhibitors, and helped to make a better exhibit.

I would further recommend that we place in the building some system of glass cases in which to exhibit and care for the delicate and costly exhibits, as under the present system a great many of the fine and costly articles get almost ruined by the dust and constant handling, and exhibitors tell me if we do not make better arrangements for the protection of their exhibits they cannot afford to exhibit.

WM. DAWSON,
Supt.

EDUCATIONAL DEPARTMENT.

This department, under the superintendency of Thos. Sattler, commissioner of schools for Jackson county, was larger than heretofore at any fair, and the quality of work is annually improving. A greater number of schools are taking an interest in the exhibit, and its growth depends almost solely on the capacity of a building to hold it. While Mr. Geo. B. Horton is the superintendent of this department, the details of the work were in the hands of Mr. Sattler, who proved very efficient and capable.

HORTICULTURAL DEPARTMENT.

Mr. Fred Postal, Esq., President State Agricultural Society, Detroit, Mich.:

Dear Sir—I herewith submit my report for the past season of the work done in the horticultural department of the State Fair, and especially of the exhibits at the annual fair, since it came under my direction;

Although the department was badly handicapped by the early date at which the fair was held, the fruit growers of the state responded freely and made what was generally conceded to be the largest and finest exhibit of fruit ever made in Michigan. Had the Fair been held three weeks later the fruit would have been much larger and higher colored, and the number of

exhibits would also have been greatly increased, as to my knowledge many fruit growers were kept from exhibiting by the lack of color in their fruit.

There were not far from 5,000 plates of fruit upon the tables, nearly all of which was very creditable and especially so considering the season. The county exhibits as usual attracted much attention, particularly that from Oceana county. Every one was also surprised at the showing made by the northern counties, especially Cheboygan, Alcona, Clare, Roscommon and Crawford. Fine exhibits were also made by Eaton, Kent, Van Buren, Macomb, Washtenaw, Oakland and Sanilac. Although not competing in the county collections, E. B. Payne, of Kalamazoo county, exhibited some superior peaches, while very fine plums were shown by O. W. Braman, of Grand Rapids. The exhibit of grapes made by W. K. Munson, of Grand Rapids, also attracted much attention, as well for the taste with which it was arranged as for the superior quality of the fruit. There were also exhibits of fruit from Lenawee and Hillsdale counties.

The exhibit of plants and flowers was not what it should have been, but the effects of showing plants in a tent the previous year were so disastrous that littie or no attempt was made to prepare an exhibit until it was too late to make a good showing. S. Taplin showed some large palms and also a number of beds filled for the most part with hardy foliage plants. Breitmeyer, Bogula and Gowanloch supplied most of the other plants. Taplin and Mrs. Schroeter exhibited designs and cut flowers. There was also a good showing of flowers by amateurs.

The exhibit of canned and preserved fruit, jellies and wines was fully twice as large as last year, and showed an improvement in the style of jars and glasses, as well as in freedom from coloring matters and adulterants.

The exhibit from the Agricultural College was also given space in the Horticultural building. This consisted of 500 plates of fruit shown by the Experiment Station, samples of grasses and forage plants, a collection of some sixty varieties of corn, models of barn frames, corn racks and seed testers, samples of the work in sewing and dress-making done by the young women, and photographs and charts showing the equipment and work of the college.

The demonstrations of spraying and fruit packing carried on each day drew a crowd to the east end of the building. The work was designed to show the methods of preparing the various insecticides and fungicides, including Bordeaux mixture, and the sulphur and lime for the San Jose scale, as well as the various types of spraying outfits. The fruit packing demonstration included an exhibit of various kinds of fruit packages, as well as a fruit grader in operation, and the method of grading and sorting fruit of various kinds was shown. After serving its purpose for the demonstration, the fruit was sold and thus served to lessen the pilfering from the tables.

The new Horticulture building seems admirably adapted to the purpose, but it should have a little more interior decoration, and office should be partitioned off in the north-east corner, and twelve more tables like those used this year should be added in order to provide for a possible increase in the extent of the exhibit next year. In fact they could have been used to good advantage this year as most of the exhibits had to be crowded together from lack of room.

From the fact that an exhibit of greenhouse plants serves better than anything eles to decorate the interior of the building, and because it not only seriously injures the plants to have them exposed to the dry air and dust for two weeks, but it is an expensive operation to haul them to the fair

grounds and back, to say nothing of the cost of caring for them, I strongly recommend that the premiums for greenhouse plants be increased, with the usual precautions that the highest premiums only be paid to worth exhibits.

The premiums for single plates of fruit are smaller than are offered by most states, and instead of the present premiums of one dollar and fifty cents, I would recommend that three premiums of $1.50, $1.00, and 50 cents, be offered, with the proviso that the first premiums will only be awarded to plates scoring 95 out of 100 points, and that to receive the second premium they must score at least 90 points. Without greatly enlarging the premium list this will greatly increase the grade of the fruit shown.

I am also considering several minor changes in the list to avoid duplication. I would also suggest that as five or six counties from the north-east series have been in the habit of exhibiting, some of which could not receive a premium, however worthy, that one or two counties be transferred to the northwest series, in which there were but two entries in 1905 and none in 1906, although two or three would have sent exhibits had it not been for the early date of the fair.

I was greatly aided in the work of superintending the installation and care of the fruit exhibit by my assistant, Mr. T. A. Farrand, of Eaton Rapids, while Miss Vesta Haney showed much taste in arranging the exhibit of canned fruit, which was placed in her charge.

Much credit is also due the judges in this department for the care given the work and the ability shown in making the awards. Mr. Thomas Gunson, Agricultural College, made the awards upon the plants and flowers; Mr. M. L. Dean, of Napoleon, upon the fruit, and Prof. F. W. Robison, of Lansing, chemist of the State Dairy and Food Commission, and Dr. Hayward, chemist of the Detroit Board of Health, passed upon the canned fruit, jellies and wines.

In conclusion, I wish to tender to you, and to the members of the business committee in particular, my hearty thanks for recognizing the importance of the department by furnishing the splendid Horticulture building for its use, and for the words of approbation upon the character of the exhibit, which you were kind enough to speak.

I cannot close, however, without expressing my appreciation of the support given the department by the horticulturists of the state, and particularly by those who made exhibits. From the beginning of the work of installing I received the heartiest co-operation from one and all, and without exception they accepted and adopted the many suggestions that from time to time it seemed advisable to offer in order to secure an harmonious exhibit.

Respectfully submitted,

L. R. TAFT,
Superintendent

MINERAL EXHIBIT.

To the President:

At the Michigan State Fair, held at the city of Detroit, from August 30th to Sept. 7th, 1906, the mineral exhibit proved one of the principal features of the Fair. From an instructive, as well as an attractive standpoint, the display of minerals was particularly unique and interesting, and perhaps among the most remarkable exhibits held in this or any other state. It was visited by thousands of people and evidently thoroughly enjoyed.

The exhibit contained specimens of every known mineral and metal found in the state of Michigan. There were specimens of crystalized native silver and and crystalized native copper; samples of minerals from the stampmills, and specimens of ingot copper from the refining furnaces, specimens of grape, needle, sponge and other forms of iron ore varieties. Also mineralized rocks from the most successful and substantial iron and copper mines operated on the Upper Peninsula and displayed in the same condition as when taken out from the underground workings. The latter seemed to appeal to the spectators in the most potent manner, for they drew forth hundreds of questions. Specimens of this class attracted more attention than the rarer minerals and curiosities. There were also in the collection rare and polished agates from South America, finely crystalized specimens of rich ores from Arizona and Montana, as well as many other varieties of more or less value from other sections.

J. L. NANKERVIS,
Acting Supt.

MARSHAL.

To the President and Members of the Executive Board of the Michigan State Agricultural Society:

Gentlemen—As marshal of Fair, 1906, I report the number of men employed by me in this department, and whose names are on the pay-roll for long or short periods, in various positions as follows: On outside fence, days, four men; on open gates where there were no ticket takers, days, three men; on buildings, nights, and to help clean grounds, six men; for cleaning up grounds, nights, four men; ushers and help on grand stand, afternoon and evening, ten men; a total of twenty-seven men, and the expense of the department was $647.50.

I desire at this time to express my appreciation of services rendered by the city and county officials, also those employed by me, they all worked faithfully to please.

All of which is respectfully submitted.

BYRON E. HALL,
Chief Marshal.

GATES.

To the President and Board of Directors, Michigan State Agricultural Society:

Gentlemen—Your Superintendent of Gates respectfully reports that during the nine days of the fair for the year 1906, nineteen men were employed taking tickets at the gates, each working an average of 10.4 hours each day, at 35 cents per hour, making total amount of pay roll $704.75.

Owing to defective registers in turn-stiles, it is impossible to state accurately the number of people passing through the gates. I am satisfied that a correct and reliable registering turn-stile is to be greatly desired.

Respectfully submitted,
F. B. RANSFORD,
Supt.

The reports were referred to the committee on Premium List and Rules. The Committee then adjourned, sine die.

Executive Committee for 1907 met at Downey House, Lansing, Tuesday, Jan. 15th, 11 A. M.

Called to order by the President.

The following members were present: The President and Messrs. A. J. Doherty, W. J. Galbraith, Wm. J. Terney, F. B. Ransford, L. C. Holden, L. R. Taft, D. D. Aitken, B. E. Hall, A. E. Stevenson, C. A. Tyler, Wm. Dawson, L. W. Snell, G. Kelly, J. F. Brand, A. Peek, V. V. Green, N. Whelan, L. W. Watkins, I. H. Butterfield, J. McKay, Eugene Fifield.

On motion a recess was taken to one o'clock P. M.

At one P. M. met.

On motion the election of General Superintendent and member of the Business Committee was taken up. Mr. A. J. Doherty was placed in nomination for general superintendent. On motion the secretary was instructed to cast the ballot of the committee for Mr. Doherty. Ballot so cast and Mr. Doherty declared elected. Mr Lawrence W. Snell was nominated for member of the Business Committee. On motion the secretary was instructed to cast the ballot of the Committee for Mr. Snell. Ballot so cast and Mr. Snell declared elected. On motion a recess was taken to 3:30 o'clock P. M.

At 3:30 P. M. committee met.

All members on roll call present.

On motion of Mr. Fifield the section of Bees and Honey was made a separate department.

Mr. Fifield moved that a superintendent for this department be appointed. Adopted.

The President appointed committee on rules: Mr. Galbraith, Mr. Stevenson, Mr. Green.

Committee on Premium List: Mr. Doherty, Mr. Snell, Mr. Fifield, Mr Butterfield and the President.

DATES OF FAIR.

Mr. Aitken moved that the dates of the Fair be August 29th, to Sept. 6th, inclusive, except Sunday.

Mr. Green moved to amend by beginning Tuesday, Aug. 27th. Amendment lost.

Original motion carried.

Mr. Doherty moved that the Fair be open three evenings.

Mr. Tyler moved to amend by referring the matter to the Business Committee. Amendment carried and motion carried.

Mr. Doherty moved that the committee recommend to the governor the reappointment of H. H. Hinds, of Stanton, as member of the State Live Stock Sanitary Commission. Carried unanimously by rising vote.

SALARIES.

Mr. Fifield moved that the salaries of officers be the same as last year. Carried.

BONDS.

The following resolution was offered by Mr. Aitken:

Resolved, That for the purpose of paying existing indebtedness and providing for improvements the Society issue second mortgage Bonds to the amount of one hundred thousand dollars and secure the same by the execution of a second mortgage of Trust deed upon all the property rights and franchises of the Society present and future, the details of such loan being

referred to the Business Committee of the Society, together with the President of the Society, and the President and Secretary are hereby authorized and directed to execute such bonds, mortgages and trust deeds as may be necessary to secure such bonds, it being understood that the rate of interest on such loan is to be not to exceed six per cent per annum.

Adopted on roll call. 22 ayes. Noes none.

It was moved that the Finance Committee be requested to complete their report and submit to the President, and that the report be placed on the records.

Carried.

Mr. Holden moved that the difference of $——— found against the Treasurer by the Finance Committee be charged off from the Treasurer's book.

Carried.

It was moved that the Treasurer file his report for record.

Carried.

The Committee on Rules reported as follows:

Your committee on Rules report some changes in the By-Laws, particularly with reference to the powers and duties of the President of the Society, and recommend their adoption.

Report accepted and adopted.

The Committee on Premium List were instructed to report to the Business Committee, and when approved by the Business Committee the report be adopted as the premium list for 1907. Carried.

Nine thousand dollars was appropriated for speed purses, the schedule to be made by the Superintendent of Speed for 18 races.

On motion of Mr. Holden the Business Committee was authorized to employ an assistant secretary and fix the compensation.

President appointed standing committees and executive superintendents as follows:

Finance Committee—Mr. D. D. Aitken, Mr. Eugene Fifield, Mr. N. J. Whelan.

Committee on Rules—Mr. W. J. Galbraith, Mr. A. E. Stevenson, Mr. V. V. Green.

Committee on Premium List—Mr. A. J. Doherty, Mr. L. W. Snell, Mr. I. H. Butterfield, Mr. Eugene Fifield, The President.

Committee on Program—The President, Business Committee and Marshal.

Committee on Reception—Mr. John T. Rich, Mr. A. E. Stevenson, Mr. J. F. Brand, Mr. B. E. Hall, Mr. W. H. Dawson.

EXECUTIVE SUPERINTENDENTS.

Cattle—Mr. C. A. Tyler.
Horses—Mr. L. C. Holden.
Speed—Mr. Eugene Fifield.
Sheep—Mr. W. E. Boyden.
Swine—Mr. George Kelley.
Poultry—Mr. Daniel Thomas.
Agricultural Building—Mr. Terney.
Dairy—Mr. L. W. Snell.
Bees and Honey—Mr. F. B. Ransford.
Vehicles—Mr. A. E. Stevenson.
Farm Implements—Mr. V. V. Green.
Main Building—Business Committee.

Art—Prof. A. H. Griffith.
Needlework—to be appointed.
Horticulture—Prof. L. R. Taft.
Educational—Mr. Geo. B. Horton.
Mineral—Mr. W. J. Galbraith.
Marshal and Supt. of Police—Mr. A. J. Peek.
Forage—Mr. Wm. Dawson.
Transportation—D. R. Hurst.
Business Committee (elected)—Mr. A. J. Doherty, Mr. L. W. Snell, Mr. I. H. Butterfield.

On motion, adjourned *sine die.*

REPORT OF THE MICHIGAN STATE ASSOCIATION OF FARMERS' CLUBS FOR THE YEAR ENDING JUNE 30, 1907.

The annual meeting of 1906 was of its usual interest. 101 delegates were present, representing 77 clubs; 103 active clubs returned the yearly report blanks, giving a total membership for Nov. 1, 1906—9006. A revised list of clubs June 1, 1907, shows 137 clubs in the state, 90 of which are members of the State Association.

Mr. J. T. Daniells, of St. Johns, ex-president of the Association and member of the Essex Farmers' Club, suggested that the Association have a motto and sentiment as follows:

Associational Motto—The skillful hand, with cultured mind, is the farmer's most valuable asset.

Associational Sentiment—The farmer: He garners from the soil the primal wealth of nations.

These were officially adopted.

Many of the clubs are having special features for their program—Young People's Day, Woman's Day, the annual picnic and the club fair. The last mentioned making the most practical program of the year.

Concerning the growth of the club movement Pres. L. Whitney Watkins in his address said:

The first individual farmers' clubs were the result of a need of better understanding among rural neighbors of conditions affecting their farms. They were the intelligent outgrowth of necessity; the meeting of kindred interests to talk things over. They preceded by many years the agricultural extension work of the Agricultural College, through the medium of the farmers' institutes and farm home reading circle. In fact it was coincident with the rapid spread of the clubs throughout the State that the demand for a more thorough knowledge of their vocation, by the better class of farmers, started the college on its present era of advancement and influence.

When the most progressive farmers of the Ingham County Farmers' Club met and organized in January, 1872, followed a little later by the Southern Washtenaw, the result was far in advance, in importance, of any similar movement in the interest of the rural communities. It was a movement born of pure interest in their homes and farms, and at first included nothing, practically, in the way of entertainment. The men simply met as representatives of invested capital and energy to devise better means for success-

ful work. The enthusiasm of the wives and daughters, who soon joined in these assemblies and brought the delightful club dinners and transferred the meetings to the various farm homes, assured the permanency of the movement and made the farmers' club meetings, as they are today, educational and enjoyable. The farmers of other progressive localities wrote for particulars and methods of organization, and the club spirit multiplied. There were no hired organizers and no inducements offered from without.

The record of the organization and development of the individual farmers' clubs of Michigan furnishes one of the world's most charming examples in rural sociology—the result of co-operation in cultured minds and active hands, for good.

And at that time the masses of the farmers, as was true of the average citizen masses in all other walks of life at an early date, did not believe in education. They had no sympathy with our university or agricultural college, nor likewise with the so-called "theory farmers" of the clubs.

Notwithstanding these discouraging, though ever present stumbling blocks of self satisfied ignorance and superstition, brains and public spirited citizenship prevailed and the clubs continued to multiply and thrive. The influences of club work in the different sections spread and met in all directions, but strangely enough there was no jealousy, and the out-stretched hands touched and grasped in friendly good-will while from this fraternal contact the State Association of Farmers' Clubs was born.

OFFICERS FOR 1907.

President—L. W. Watkins, Manchester.
Vice-President—Mrs. E. A. Ross, Milford.
Secretary—Mrs. W. L. Cheney, Mason.
Treasurer—Mrs. Sara C. Taylor, Novi.

DIRECTORS.

	Term expires.
James P. King, Marshall, R. F. D. No. 4	1907
Rev. J. B. Reynolds, Hartford	1907
Hon. W. A. Reed, Hanover	1908
Frank Clark, Vernon	1908
D. M. Beckwith, Howell	1909
D. M. Garner, Davisburg	1909

MRS. W. L. CHENEY,
Sec.

INDEX.

INDEX.

A.

B.

D.

E.

F.

N.

O.

P.

Y.

Z.